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COMMAND AND CONTROL IN NEW NUCLEAR STATES:
IMPLICATIONS FOR STABILITY

By
David C. Foley
June 1994

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Implications For Stability

by
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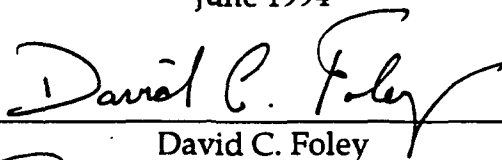
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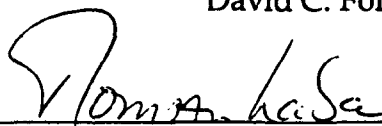
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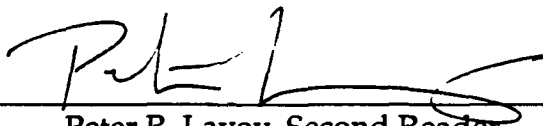
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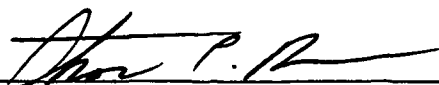
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ABSTRACT

Command and control systems of new nuclear states are likely to fail when placed under stress. This thesis will demonstrate that such failures can dramatically affect regional or international stability. Describing the current argument over the consequences of nuclear proliferation between proliferation pessimists and deterrence optimists, the thesis shows how C2 is in fact the crux of the debate. This thesis develops an analytical tool that may be applied to new nuclear states in order to classify their C2 systems and to predict when and how these evolving systems might fail. To show the tool's usefulness, it is applied to Ukraine, an important new nuclear state. This thesis also suggests several implications for U.S. foreign policy.

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EXECUTIVE SUMMARY

Since the demise of the Soviet Union in December 1991, world attention has been increasingly focused on the issue of nuclear weapons proliferation. When the USSR ceased to exist, four former Soviet Republics suddenly emerged on the international scene as potential nuclear weapons-capable states: Russia, Ukraine, Kazakhstan, and Belarus. This event represented an enormous challenge to international arms control efforts as well as to the very existence of the Nuclear Non-Proliferation Treaty itself. As a result, Western and U.S. non-proliferation energies have been galvanized around status quo maintenance of the NPT regime. U.S. foreign policy, in both the Bush and Clinton administrations, centered on denuclearization of all former Soviet republics except for Russia. This policy was based on the premise that the periphery states of Belarus, Ukraine and Kazakhstan were politically unstable, unknown quantities which had little experience with large-scale nuclear operations. Relatively more stable and the center of the former Soviet Union, Russia was considered the natural and only legitimate nuclear inheritor of the Soviet Union.

Yet concerns over nuclear non-proliferation are not limited to the geography of the Former Soviet Union, and in fact have multiplied since the beginning of this year. International attention is currently riveted upon North Korea's nuclear operations. Western intelligence agencies believe that North Korea is either in the final stages of developing nuclear weapons or is

adding to its arsenal. At this time the Clinton Administration is proposing heavy international economic sanctions upon North Korea unless it permits International Atomic Energy Agency (IAEA) inspections and backs away from nuclear weapons construction. North Korean leader Kim Il-Sung has responded by declaring that any form of sanctions would be considered an act of war. Seoul has mobilized its military reserves.

Others are more sanguine about the crisis. Some South Koreans do not believe that Kim Il-Sung would ever strike the South with nuclear weapons even if he did possess them. In the U.S., long-time Asian scholar Claude Buss is also more concerned with intent rather than the existence of nuclear weapons: he doubts that Kim would push the button. It is precisely at this point in the debate over North Korea, or Ukraine, or any new nuclear state for that matter, where this thesis intervenes. The question to be asked is this: Do the C2 systems of new nuclear states contain hidden vulnerabilities which, when strained by crisis, may cause the system to fail? And if they fail, would it adversely effect regional or international stability?

Whether it is North Korea today, Ukraine tomorrow or possibly Iran next week, the point is not to be pessimistic or optimistic about nuclear proliferation but to be practical. Leaders of new nuclear states *may not* want to deploy their arsenals; they may want them strictly for reasons of prestige and politics. The nuclear C2 systems themselves, however, may fail at a critical moment and escalate a crisis into a nuclear exchange. This would destroy regional or international stability.

This thesis addresses the likelihood that nuclear C2 structures in new nuclear states contain inherent vulnerabilities which, when the system is

placed under stress, will cause it to fail. The thesis will demonstrate that C2 vulnerabilities and potential failures have definite impacts upon regional and international stability. As information on C2 systems in new nuclear states is extremely limited, a general deductive framework for analysis will be put forward. To highlight the relevance of the topic, Ukraine is the specific case study upon which the general framework will be overlaid, to try to determine what form its C2 system would take along with the corresponding implications for stability. It will be demonstrated that a similar evaluation could be performed on any new or potential nuclear state.

This thesis makes several conclusions. First, command and control systems themselves are at the heart of the arguments surrounding nuclear proliferation. Second, command and control systems are therefore the keys to stability in new nuclear states. Third, analytical tools are required to unmask the obscure command and control systems in these states. Such tools may also identify specific vulnerabilities inherent in the command and control systems of new nuclear states. Fourth, Ukraine's nuclear command and control system, if it exists, is likely to fail, should a crisis develop. If a failure occurred, it would likely result in the use or detonation of a nuclear weapon; such a failure is termed "deadly." Finally, this thesis suggests that the U.S. government reconsider efforts to assist new nuclear states attain safe, secure and reliable nuclear forces.

I. INTRODUCTION

Since the demise of the Soviet Union in December 1991, world attention has become focused on nuclear weapons proliferation. When the USSR ceased to exist, four former Soviet Republics suddenly emerged as potential nuclear weapons-capable states: Russia, Ukraine, Kazakhstan, and Belarus. This event represented an enormous challenge to nuclear arms control agreements between the U.S. and the Soviet Union as well as to the Nuclear Non-Proliferation Treaty (NPT).¹ U.S. foreign policy, in both the Bush and Clinton administrations, centered on denuclearization of all former Soviet republics except for Russia. This policy was based on the premise that the periphery states of Belarus, Ukraine and Kazakhstan were politically unstable, unknown quantities which had little experience with large-scale nuclear operations.² Russia, having been the center of the Soviet Union and considered relatively more stable, came to be viewed by Washington as the only legitimate nuclear inheritor of the Soviet Union.³

Efforts to this end have been marginally successful: Belarus and Kazakhstan have agreed to divest themselves of their nuclear arsenals and will join the NPT as non-nuclear weapons states. Ukraine, however, has only recently agreed to adhere to the NPT and

¹ The Nuclear Non-Proliferation Treaty or NPT is an internationally ratified document which stipulates that only five states may possess nuclear weapons: the U.S., Russia, China, France and the UK. It is due for re-ratification in 1995.

² Kurt M. Campbell, Ashton B. Carter, Steven E. Miller and Charles A. Zraket, Soviet Nuclear Fission: Control of the Nuclear Arsenal in a Disintegrating Soviet Union, (Cambridge, Mass: Center for Science and International Affairs, Harvard University, November 1991).

³ Interview with U.S. Ambassador to Russia Strobe Talbot in Jane's Defence Weekly, Vol. 20, No. 8, 7 August 1993. Also see Campbell, et. al., Soviet Nuclear Fission.

begun to turn over elements of its strategic nuclear arsenal to Russia for dismantlement (due to end in 1997).⁴ This process does not promise to be easy considering both the internal and external threats to Ukraine's survival.

Yet concerns over nuclear proliferation are not limited to the newly independent states of the Former Soviet Union, and in fact have multiplied since the beginning of this year. International attention is currently riveted upon North Korea's nuclear operations. Western intelligence agencies believe that North Korea is either in the final stages of developing nuclear weapons or is adding to its arsenal.⁵ Recently the Clinton Administration considered heavy international economic sanctions upon North Korea unless it permitted International Atomic Energy Agency (IAEA) inspections and backed away from nuclear weapons construction.⁶ North Korean leader Kim Il-Sung, having originally responded by declaring that any form of sanctions would be considered an act of war, has now agreed to U.S. demands.⁷

Others are more sanguine about the crisis. Some South Koreans do not believe that Kim Il-Sung would ever strike the South with nuclear weapons even if he did possess them.⁸ In the U.S., long-time Asian scholar Claude Buss is also more concerned with intent rather than the existence of nuclear weapons: he doubts that Kim would push the button.⁹ The intent to use nuclear weapons is certainly an aspect of proliferation not to

⁴ Under terms of the Trilateral Statement, signed by Ukrainian President Kravchuk in January 1994 and ratified by the Ukrainian Rada in February, Ukraine is to denuclearize by 1997 in return for financial compensation and international security guarantees.

⁵David E. Sanger, "The Pyongyang Puzzle," New York Times, 1 June 1994, A1.

⁶David E. Sanger, "Tokyo Reluctant to Endorse Sanctions," New York Times, 9 June 1994, A1.

⁷Ibid.

⁸David E. Sanger, "South Korea Worries Transcend Bomb," New York Times, 12 June 1994, A6.

⁹Interview, 10 June 1994.

be overlooked. However, while much attention has focused on the development and possession of nuclear weapons themselves, little has concentrated on the systems used to command and control them. It is precisely at this point in the debate over North Korea, or Ukraine, or any other new nuclear state, where this thesis intervenes. The question to be asked is this: Do the command and control systems of new nuclear states contain hidden vulnerabilities which, when strained by crisis, may cause the system to fail. An attendant question is, if they fail, what might be the impact upon regional or international stability? This thesis proposes that there exists a relationship between the nuclear command and control systems in new nuclear states and stability. Stability is defined for the purpose of this thesis as the absence of military conflict between states. Should nuclear command and control systems fail, through accidental or inadvertent weapon employment or detonation, regional and international tensions are very likely to escalate beyond the control of diplomacy and mediation.

To portray the relationship between a new nuclear state's command and control system and stability, it is useful to consider the following scenario: over the next several weeks diplomatic talks between the U.S. and North Korea falter and tensions on the Korean peninsula continue to mount. Suddenly a massive explosion near the Yongbyon nuclear complex in North Korea is detected by U.S. and South Korean intelligence systems. Perceiving this to have been an accidental nuclear detonation of a warhead in transit to its delivery vehicle, the U.S. and South Koreans launch a surgical air strike against the North. Kim Il-Sung, believing that the explosion was an attempted pre-emptive strike by the U.S. and the ROK, gives the order to unleash his nuclear arsenal before it is struck. The result: nuclear bombs reach Seoul causing tremendous devastation. General war is declared and casualties run into the millions.

Whether it is North Korea today, Ukraine tomorrow, or possibly Iran next week, nuclear weapons proliferation continues. In this case it is important to look beyond mere

weapon possession. Leaders of new nuclear states *may not* want to deploy their arsenals; they may want them strictly for reasons of prestige and politics. The nuclear command and control systems themselves, however, may fail at a critical moment and escalate a crisis into a nuclear exchange. Such a failure would thereby destroy regional or international stability.

A. COMMAND AND CONTROL STRUCTURES: UNKNOWN QUANTITIES

This thesis addresses the likelihood that nuclear C2 structures in new nuclear states might contain inherent vulnerabilities which, when the system is placed under stress, will cause them to fail. The thesis will demonstrate the relationship between C2 vulnerabilities and regional and international stability. Information on C2 systems in new nuclear states is extremely limited, thus a general deductive framework for analysis is put forward. Ukraine is the specific case study upon which the general framework will be overlaid, to try to determine what form its C2 system would take along with the corresponding implications for stability. It will be demonstrated that a similar evaluation could be performed on any new or potential nuclear state.

B. THESIS ORGANIZATION

The next chapter discusses the importance of C2 to nuclear operations in new nuclear states. It demonstrates how command and control relates to the arguments between proliferation pessimists and deterrence optimists.¹⁰ It also develops a framework for analysis of C2 in new nuclear states by suggesting a typology of these states and their C2 systems. Chapter III presents three models of C2 for analysis: the U.S., Soviet and South

¹⁰These terms were first used by weapons proliferation specialist Peter R. Lavoy. See Lavoy, "Nuclear Myths and the Causes of Nuclear Proliferation," Security Studies, Vol. 2, No. 3/4, Spring/Summer 1993, pp. 192-212. See also Scot Sagan, The Limits of Safety, (Princeton, Mass.: Princeton University Press, 1993), 264.

Asian. These models provide the context for discussion of how other, new nuclear states, might seek to develop their C2 systems. The three models are used deductively and comparatively in chapter IV, where Ukraine used as a case study of the implication for stability that new nuclear states' C2 contain. Chapter V draws some conclusions about the importance of C2 in new nuclear states in general and several implications for U.S. foreign policy.

II: THE IMPORTANCE OF C2 WITHIN THE ARGUMENTS OF PROLIFERATION

It is necessary to understand the current philosophies surrounding the broader issue of the proliferation of nuclear weapons in order to demonstrate the specific connection between command and control (hereafter C2) systems and stability. This chapter reviews first the arguments of those pessimistic about the spread of nuclear weapons, then those who view nuclear deterrence more optimistically. It then explores how command and control is central to these arguments; C2 vulnerabilities fuel the pessimists concerns while robust C2 structures lead optimists to believe that proliferation can be stabilizing. The concepts of command and control and stability are defined, the goals of command and control examined, and finally, implications for stability are explained.

A. THE PROLIFERATION DEBATE

Concern over the potential spread of nuclear weapons has existed from the dawn of the atomic age.¹¹ The proliferation debate spearheaded by analysts and policy makers in the United States has traditionally been split into two opposing camps: those who see some merit in the increase of states possessing nuclear weapons and those who do not.

¹¹Bernard Brodie, The Absolute Weapon, (New York: Harcourt, Brace and Co., 1946).

1. Concerns of Proliferation Pessimists

Exemplifying what is the official position of the U.S. government, the current Director of Naval Intelligence, RADM Edward D. Schaefer, Jr., has predicted that a nuclear weapon will be exploded in anger within the next ten years.¹² Similarly, Leonard Spector claims that "the spread of nuclear weapons poses one of the greatest threats of our time and is among the most likely triggers of a future nuclear holocaust."¹³ The logic behind Spector's thinking is that nuclear devices and delivery systems cannot be made to be completely safe and foolproof. Stephen Miller, Ashton Carter and other arms control specialists concur: as the number of nuclear weapon-capable states increase, so do the chances for some sort of nuclear incident, whether intentional or otherwise.¹⁴ This camp has a number of concerns over nuclear weapons proliferation in new nuclear states:

1) Nuclear weapons will be developed by countries led by irrational dictators or religious zealots, cases in point being Iraq, North Korea or Iran.¹⁵

2) Nuclear weapons could be sold to or stolen by para-military or terrorist organizations and used to further their specific agendas via nuclear blackmail.¹⁶

3) Leaders of nuclear weapons states might lose control over some or all of their nuclear forces in times of extreme crisis (coup attempts, civil strife, etc.)

¹²Lecture given at the Naval Postgraduate School, March, 1994.

¹³Leonard Spector, Nuclear Proliferation Today, (New York: Vintage Press, 1984), 3.

¹⁴For greater development of this issue, see Kurt M. Campbell, et. al., Soviet Nuclear Fission.

¹⁵Spector, pp. 4, 12.

¹⁶*Ibid*, 4.

4) Nuclear forces in states with less economic resources may not be able to afford adequate weapon safeguards or testing which could prevent inadvertent use or detonation.¹⁷

5) Emerging nuclear states will be vulnerable to military strike by regional rivals to prevent the development of nuclear arsenals.¹⁸

2. The Perspective of Nuclear Deterrence Optimists

The first serious attempt to cast a more positive light on the proliferation of nuclear weapons was the 1981 work of Kenneth N. Waltz, The Spread of Nuclear Weapons: More May Be Better. He proposed that nuclear weapons capability could generate strategic stability among states. One of Waltz's fundamental assumptions is that "uncertainty and miscalculation cause wars."¹⁹ He claims that in a nuclear world, "a nation will be deterred from attacking even if it believes that there is only a possibility that its adversary will retaliate."²⁰ According to Waltz, the devastating power of the nuclear weapons possessed by the United States and Soviet Union prevented either side from initiating direct military confrontation against each other. This is the heart of deterrence theory.²¹ In Waltz's words, "victory in (nuclear) war is too dangerous to fight for; If states can score only small gains, because large ones risk retaliation, they have little incentive to fight."²²

¹⁷Sagan, 266.

¹⁸Ibid, 267.

¹⁹Kenneth N. Waltz, The Spread of Nuclear Weapons: More May Be Better, Adelphi Paper No.171,(London: IISS, 1981), 2.

²⁰Waltz, 16.

²¹Peter D. Feaver, "Proliferation Optimism and Theories of Nuclear Operations," Security Studies, Vol. 2, No. 3/4, (Spring/Summer 1993), 160.

²²Waltz, 5.

Waltz believes that nuclear deterrence is likely to hold for all states, even emerging nuclear weapons states. Waltz claims that a pre-emptive strike against states with small nuclear arsenals is not so easy:

It is so only if the would-be attacker knows that the and locations, and knows that they will not be moved or fired before they are struck. To know all of these things, and to know that you know them for sure, is exceedingly difficult.²³

If a pre-emptive military operation is not completely effective, the possibility exists that one or more of your opponent's nuclear weapons remains and may yet be delivered, thereby producing unacceptable damage. This uncertainty would give pause to even the most aggressive of states, for as Waltz says, "uncertainty deters and there would be plenty of uncertainty."²⁴ In this way, adventuristic states would be less likely to initiate actions which could raise the chances of interstate conflict, possibly involving nuclear weapons. Such nuclear "leavening" thus works to diminish tensions and increase regional or international stability.

John Mearsheimer is another leading nuclear deterrence optimist. Writing in the journal International Security in 1990, Mearsheimer forecast four future scenarios for Europe, with the "least dangerous" scenario being one of nuclear proliferation "well-managed by the current nuclear powers."²⁵

Inside of Mearsheimer's paradigm for peace and stability, however, are nuclear weapons. Nuclear weapons "vastly expanded the violence of war, making deterrence far more robust."²⁶ Nuclear weapons not only act as deterrents, guaranteeing extremely high

²³*Ibid.*, 16.

²⁴*Ibid.*, 15.

²⁵John Mearsheimer, "Back To the Future," International Security, Summer 1990, (Vol. 15, No. 1), 8.

²⁶*Ibid.*, 11.

cost during conflict, but are more useful to states seeking to protect the status quo than to states seeking conquest. This also reinforces stability.²⁷

Mearsheimer also addresses the concern of proliferation pessimists about irrational leaders possessing nuclear weapons. This is a growing concern considering the recent surges of Neo-Nazism in Germany and the rise of the Russian Right, exemplified by the ultra nationalist parliamentarian, Vladimir Zhirinovsky.²⁸ Mearsheimer claims that malevolent nationalism encouraged by such leaders is more likely to develop "under military systems that require reliance on mass armies" since state leaders may have to exploit nationalistic sentiments in order to fill and sustain large armies. In contrast, military regimes based upon highly technical security arrangements, such as nuclear weapons, are much less susceptible to nationalistic exploitation thus work to dampen nationalism generally.²⁹ As a result of these propositions, Mearsheimer believes that expanded (but managed) nuclear proliferation would tend to equalize military power among states and thus bolster strategic stability generally.

B. COMMAND AND CONTROL IN THE PROLIFERATION DEBATE

As presented above, the main schools of thought disagree over the degree of nuclear proliferation. Pessimists believe that nuclear weapons may enhance stability only if possessed by great powers while optimists argue that nuclear weapons may be stabilizing influences in third world states as well. The point of this chapter is to demonstrate the

²⁷Ibid, 20. Mearsheimer's point is that in situations where two sides have nuclear weapons, conflicts will be ones of will over military capabilities: the conflict will be "won" by the side willing to "run greater risks and pay greater costs." He believes that defenders generally value their independence greater than any rival values conquest, thus giving the edge to the defender who would risk nuclear use to save his state.

²⁸See Stephen Kinzer, "A Climate For Demagogues," The Atlantic Monthly, February 1994, pp. 21-34 and Celestine Bohlen, "Zhirinovsky Cult Grows: All Power to the Leader," New York Times, 5 March 1994, pp. A1,A6..

²⁹Mearsheimer, 21.

crucial connection between command and control systems and the arguments over the strategic effects of nuclear proliferation. It is demonstrated that C2 systems are crucial elements in nuclear weapons systems yet may in fact be sources of danger and instability. C2 systems have inherent vulnerabilities which, if not addressed, can lead to geopolitical instabilities. In order to show implications for stability in emerging nuclear states, it is necessary to first define the terms command and control and stability. The role of C2 systems in general is explored and the goals and objectives of nuclear C2 systems is put forth.

1. Terms Defined

A good starting point is with the concept of command and control. The official U.S. Department of Defense definition reads as follows:

Command and control: The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities and procedures which are employed by a commander in planning, directing, coordinating and controlling forces and operations in the accomplishment of the mission.³⁰

Carter, Steinbruner and Zraket define the command system as including "the sensors, communications links, and command centers that form the physical network as well as the plans, procedures, organizations, and widely shared assumptions that allow

³⁰George E. Orr, Combat Ops C3I: Fundamentals and Interactions, (Maxwell AFB, Ala.: Air University Press, 1983), 23.

the parts to work together coherently.”³¹ In essence, C2 affects the human interface with mechanical structures that allows weapons, in this case nuclear, to be deployed.

Like command and control, the concept of stability is not simple to define.

Webster's New Collegiate Dictionary defines it this way:

- a. The strength to stand and endure: Firmness;
- b. The property of a body that causes it when disturbed from a condition of equilibrium or steady motion to develop forces or moments that restore the original condition;
- c. Resistance to...change or physical disintegration.³²

John Mearsheimer is less complex: “Stability is simply defined as the absence of wars and major crises.”³³

While it is clear that stability in relation to military/nuclear forces equates to minimized or zero armed conflict between states, the concept may have additional dimensions. Waltz discusses the connections between nuclear weapons and both *domestic* and *regional* stability. Elements of domestic stability appear to be the capability of “maintaining external security and internal order.”³⁴ Waltz seems to define regional stability as both the lack of “radical” behavior between neighboring states and the existence of a “bipolar pattern” in a specific geographic area.³⁵

³¹ Ashton B. Carter, John D. Steinbruner and Charles A. Zraket, ed., Managing Nuclear Operations, (Washington, DC: Brookings, 1987), 1.

³² Webster's New Collegiate Dictionary, (Springfield, Mass.: G. and C. Merriam Co., 1981).

³³ Mearsheimer, 7.

³⁴ Waltz, 10.

³⁵ *Ibid.*, 12.

All of these descriptions are applicable to this study of nuclear C2 systems in new nuclear states. If a state has difficulty maintaining domestic stability for instance, it may lose control of its nuclear arsenal. Whether the result is theft or detonation, other states, both in the region and beyond are effected. For the purpose of this thesis, however, the focus is on the C2 structure itself and how it might respond to threats internal and external. It is proposed that C2 systems may be ill-equipped to deal with pressures placed upon it and thus fail. These failures could result in theft resulting in nuclear blackmail or accidental detonation or inadvertent employ of weapons. These eventualities would clearly exacerbate regional and international relations possibly leading to armed conflict. For purposes of this thesis then, stability is defined as the status of reduced tensions, or peace, between nation-states.

2. The Importance of Command and Control

Neither deterrence optimists nor proliferation pessimists fail to mention the crucial impact of command and control on nuclear regimes. In his belief in the positive, stabilizing effects of the spread of nuclear weapons, Waltz states that a credible nuclear deterrent must meet at least three requirements:

First, a part of the force must appear to be able to survive an attack and launch one of its own. Second, survival of the force must not require early firing in response to what may be false alarms. Third, weapons must not be susceptible to accidental and unauthorized use.³⁶

Each of Waltz's three requirements are direct functions of C2. Force survivability, for instance, is an issue of hardening of silos and storage sites, hiding weapons, and communications between command centers and nuclear forces during or

³⁶Ibid. 15.

after a nuclear barrage. The concern over deployment of nuclear weapons due to false alarms is a matter of the interaction of command authorization with the technical aspects of intelligence and early warning systems. Accidental or unauthorized use of nuclear forces are also issues of command and control.

From the opposing side of the proliferation argument, Leonard Spector expressed the concern that "the more nations that possess nuclear weapons, the greater the risk that such arms will be used accidentally or inadvertently."³⁷ Spector believes that "no nuclear command and control system can be foolproof."³⁸ These concerns fall into the realm of safeguards, major imperatives of command and control. Safeguards include physical security of weapons, authorized access, technical mechanisms on the warhead itself to keep the weapon inert until actually employed, etc. C2 plays an extremely important, perhaps vital, role in nuclear deterrence as well as in concerns over proliferation: if nuclear arsenals lack components that make them safe and ensure credibility, stability may be in jeopardy.

3. Goals of Command and Control Systems

There are three general goals towards which all of the organizational, doctrinal and technical aspects of nuclear C2 are arranged: the security, safety and reliability of nuclear forces. Peter Feaver defines secure weapons as those "resistant to efforts by unauthorized people to detonate them."³⁹ The concept of security calls into play the varied C2 issues of physical security of weapons during production, storage and trans-shipment. Doctrine and procedures for handling weapons within nuclear facilities and

³⁷Spector, 4.

³⁸Ibid, 4.

³⁹Peter D. Feaver, "Command and Control In Emerging Nuclear Nations," International Security, Vol. 17, No. 3 (Winter 1992/93), 163.

deployment sights as well as the fashioning of safeguards on the weapons or delivery vehicles themselves are also areas of security concerns.

A safe weapon is one that is not prone to accidental detonation.⁴⁰ The safety of nuclear weapons may be achieved through various efforts: co-locating bomb components geographically yet not assembling them until called for;⁴¹ installation of safe-arm devices such as mechanical safe-arm devices (MSADs), permissive action links (PALs) or environmental sensing devices (ESDs).⁴²

Feaver defines reliability, the last of the three main goals of a nuclear force command and control system, as a condition prevailing so that weapons are "unlikely to fail at the moment when leaders want to use them."⁴³ To insure such reliability, the weapons must be tested to demonstrate that they will perform as advertised, and equally critical from the C2 perspective, communications between state leaders and the weapons themselves must be robust and redundant. If a state is unable or unlikely to meet the goals of security, safety and reliability of its nuclear forces, then its C2 system is in question and implications for instability abound.

C. A FRAMEWORK FOR ANALYSIS

Now that it has been determined that C2 concerns are integral to the arguments surrounding nuclear proliferation, it is necessary to explore the vulnerabilities of different

⁴⁰Feaver, 163.

⁴¹Known as non-weaponized deterrence. It is the concept of having the requisite components of a nuclear weapon constructed, but not assembled. It is thought that the nuclear arsenals of India and Pakistan are maintained in this fashion. See George Perkovich, "A Nuclear Third Way In South Asia," Foreign Policy, No. 91, Summer 1993.

⁴²For PALs and ESDs see Bruce Blair, The Logic of Accidental Nuclear War, (Washington, DC: Brookings, 1993), pp. 107, 278; for MSADs see Scott D. Sagan, The Limits of Safety: Organizations, Accidents and Nuclear Weapons, (Princeton, NJ: Princeton University Press, 1993), pp. 184-185.

⁴³Feaver, "C2 In Emerging Nuclear Nations," 163.

types of C2 systems. Such exploration is essential to determine whether or not the systems themselves could unintentionally exacerbate national, regional or international tensions which could cause a precipitous escalation of a crisis resulting in military, or worse, nuclear, conflict.

1. The Two Aspects of C2: Positive and Negative Control

Positive control over nuclear forces refers to a state's ability to effectively deploy such forces at its discretion. Negative control is a state's ability to deny unauthorized use of its nuclear forces.⁴⁴ Peter Feaver terms this the "always/never dilemma," the condition where state leaders can always count on the reliability of their nuclear forces while knowing that unauthorized use will never occur.⁴⁵

2. Threats to Positive and Negative Control

The distinct aspects of C2 exhibit differing vulnerabilities and experience differing threats to control. The primary assault on positive control of a state's nuclear force is pre-emption. A pre-emptive strike is conducted by one state against another in the hope of knocking out the other state's capability to retaliate.⁴⁶ Pre-emption assumes great significance in the realm of nuclear deterrence: if a state can achieve a successful pre-emptive strike against its opponent's nuclear force, the opponent will have lost the ability to retaliate with unacceptable damage and thus nuclear deterrence will have failed. The state which has lost its nuclear response is now impotent and at the mercy of its enemy's dictates.⁴⁷ Several strategies of pre-emption exist. One is to strike at an

⁴⁴Ibid, 163 and John D. Steinbruner in Managing Nuclear Operations, 539.

⁴⁵Feaver, "Command and Control In Emerging Nuclear Nations," 162.

⁴⁶For a good treatise on the differing concepts of pre-emptive versus preventive military strikes, see Waltz, The Spread of Nuclear Weapons, pp. 14-17.

⁴⁷John D. Steinbruner develops this issue more fully in "Nuclear Decapitation," Foreign Policy, No.45, (Winter 1981-82), 16-28.

opponent's nuclear weapons themselves. Another is to hit the delivery vehicles.⁴⁸ Yet another is to cut off a state's ability to command the weapons and vehicles at its disposal. Cold War studies have revealed that such a strategy, termed decapitation, was vigorously pursued by both superpowers.⁴⁹ As C2 came to be viewed as the weakest link in the nuclear chain, both the U.S. and the Soviet Union invested massively into efforts to protect C2 elements: command bunkers, mobile command posts, communications links hardened against the effects of electro-magnetic pulse, etc.⁵⁰

While decapitation threatens a state's ability to command its nuclear arsenal, the issue of unwanted use is the main challenge to negative control. This challenge may be further broken down into accidental and unauthorized use. Peter Feaver states that "unwanted use is destabilizing."⁵¹ Nuclear accidents would cause a tremendous amount of physical and ecological damage, as well as many casualties. Use of nuclear weapons without authorization would likely trigger a nuclear or conventional military response or both.

3. Delegative Versus Assertive C2

Concerns over threats to a state's positive and negative control of its nuclear forces compel states to respond to these challenges by adoption of measures which result in greater or lesser control over its weapons. Should a state fear decapitation, it might opt for measures to ensure positive control, or command, over its forces. In this case a state would be concentrating on achievement of the goal of reliability. Towards this end, state leaders might feel compelled to provide lower-echelon commanders with the legal

⁴⁸Both Feaver and Perkovich agree that small arsenals are choice targets for pre-emptive strikes.

⁴⁹See Blair, pp.124-126.

⁵⁰Soviet leadership went to extreme lengths in these areas. See Blair, pp. 59-115.

⁵¹Feaver, "C2 In Emerging Nuclear Nations," 164.

authorization to release their nuclear weapons should central or national command authority (NCA) be neutralized by a decapitative strike. Such devolution of nuclear weapon release authority is termed delegation or pre-delegation.⁵² An important aspect of a delegative system is that even if lower-echelon commanders have not been given clear legal authorization to release the weapons at their discretion, there are few physical mechanisms in place to prevent them from doing so.⁵³ The U.S. command system is replete with examples of how nuclear authority evolved from an assertive to pre-delegative stance.⁵⁴

A state more preoccupied with the goals of security would lean more towards insuring negative control over its nuclear forces. The NCA of this state would institute measures to permit it assertive control over the use of its weapons. In this case lower-echelon commanders may or may not have legal authorization to use nuclear weapons under their command, but intrusive mechanisms would be in place to prevent use without specific authorization from above. A C2 system with a more assertive bent would depend less on subordinate loyalty as on use control devices such as PALs, or procedures requiring multiple personnel to be present every time nuclear warheads were accessible.

4. C2 Failure Modes

A new nuclear state's existing C2 structure represents a de facto resolution of that state's consideration of positive and negative control, or Feaver's always/never dilemma. This obtains whether or not a state has given these issues much thought or not.

⁵²See Feaver, 168 and Blair, pp. 45-52.

⁵³Feaver, 169.

⁵⁴Paul Bracken reviews this in depth in Command and Control of Nuclear Forces. The Command and Control of Nuclear Forces. (New Haven: Yale University Press, 1983). See specifically pp. 197-200. For analysis of the U.S. Navy's nuclear delegation authority see George E. Miller, "Who Needs PALs?," Proceedings of the U.S. Naval Institute, July 1988, pp. 50-56.

For example, South Africa had not taken these points into consideration at all. Moreover, when confronted with the implications for stability, the South Africans were apathetic.⁵⁵ Ignorance of the issues of C2 vulnerabilities by leaders of nuclear states is what is at issue, because systemic C2 vulnerabilities may lead to C2 failures. Such failures could prove all the more catastrophic if they appear in realms least-expected by state leaders.

Peter Feaver has estimated that C2 systems that are more delegative in their orientation are likely to fail "deadly."⁵⁶ Delegative systems, precisely because they fear a pre-emptive loss of force or decapitation, will assume a "hair trigger" posture and be prepared to launch on warning. As a result, lower-echelon commanders, in the midst of crisis, might deploy the nuclear weapons under their cognizance due to misperception, inaccurate intelligence or accidental/temporary loss of communications with national command authority. In such a scenario the commander might believe he was truly acting in the best interest of his country, even believe that he was acting under pre-delegated orders, in deploying his nuclear weapons. Meanwhile, the NCA, with superior "big picture" intelligence or unaware of some sort of communications failure, could only look on with surprise and horror as one of its own nuclear-tipped missiles or aircraft with nuclear bomb on board disappeared over the horizon. Thus the C2 system failed deadly: the failure resulted in the use of nuclear weapons.

With assertive systems, the physical, intrusive safeguards take time to overcome before the weapons can be used. Under attack, the time required to "unlock" all of the protective mechanisms might be too great to be able to disperse or deploy the weapons before they are destroyed on the ground. Thus it is postulated that assertive systems

⁵⁵Counter proliferation specialist Mitchel Reiss raised these concerns with South African officials during a recent visit to Pretoria. According to Reiss, the officials "didn't care at all." Interview, 20 May 1994.

⁵⁶Feaver, 162.

might fail "safely" or "impotently."⁵⁷ While such a circumstance would prove unfavorable to the state under actual nuclear attack, a relatively slower, less reactionary C2 system might prove a god-send in the case where a perceived strike turned out to be a false alarm. If John Mearsheimer is correct in his proposition that nuclear weapons are better suited to function as defensive vice offensive weapons, this suggests that an assertive C2 structure may prove to be a more stabilizing system than a delegative one in a confrontation between two nuclear-armed rivals.⁵⁸

5. Determinants Of C2 Structure

There are several factors which impact upon a new nuclear state's decision to construct either a more delegative or more assertive command and control structure. Peter Feaver believes that civil-military relations and the issue of time-urgency are two such factors. Applying organizational theory, Feaver states that "insiders" of large bureaucracies "naturally resist outsiders' interference in cherished operations, and jealously guard their autonomy of activity." Military commanders, then, would prefer a delegative C2 structure.⁵⁹ Contrarily, bureaucratic leaders "seek mechanisms to enhance their control over the behavior of critical elements of an organization."⁶⁰ This leads to the conclusion that civilians prefer more assertive control. If this is true in general, then

⁵⁷Ibid, 162.

⁵⁸Mearsheimer, 20. Waltz is also skeptical of the likelihood that a state would actually attempt a pre-emptive strike. See Waltz, 16.

⁵⁹Feaver, 175.

⁶⁰Ibid, 175.

the logic should particularly apply *a fortiori* to nuclear operations where the costs of loss of control can be so high.⁶¹

The concept of civil-military relations is further broken down by Feaver into the categories of stable versus volatile. States having experienced a stable pattern of relations between the civilian government and the military, in which governance has been separate from the military, typically results in a greater delegation of authority. If the military has played a greater role in running the country (periodic coupe de etats, power-sharing, etc.) and the civilian government is weak, the pattern of civil-military relations is volatile and increases the need for more assertion by government leaders. Feaver suggests this may be more problematic if nuclear weapons are viewed as "symbols of political power:" the weapons themselves may "become stakes in a domestic power struggle."⁶² Under such circumstances, assertive C2 would be even more highly valued.

Feaver's second factor which determines C2 proclivity towards delegation or assertion is what he terms time-urgency: "the degree to which the leaders of the new nuclear state require that the arsenal be ready for immediate and rapid use."⁶³ Under the rubric of time-urgency, other issues emerge as contributing factors. New nuclear states are likely to have small arsenals and limited numbers of delivery systems. Most new nuclear states have regional rivals⁶⁴ and some lack the geographic size to widely disperse their weapons. As a result, the national command authorities in these states will be faced

⁶¹Feaver seems to have constructed the civil-military factor upon the basis of overall civilian control. It would be curious to see if the logic holds within purely militaristic regimes: do lower-echelon commanders desire more autonomy over nuclear weapons than national (military) leaders would want to extend?

⁶²Feaver, 176.

⁶³Ibid, 178.

⁶⁴Ibid, 178. Also, a long-time U.S. government analyst commented that leaders of new nuclear states and potential nuclear states are reading the literature of deterrence optimists and believing the validity of that side of the proliferation debate. Interview, 25 May 1994.

with the challenges of a pre-emptive, surgical strike against their arsenals combined with extremely brief reaction times.⁶⁵ These conditions, individually or collectively, function to impart to the new nuclear state "a strong incentive to use the arsenal early in a conflict before the enemy destroys it," according to Feaver.⁶⁶ This leads once again to a "hair trigger" posture which could lead to de-stabilizing and undesired crisis escalation.

While Feaver's factors of civil-military relations and time-urgency are instructive, they are not all-inclusive. Other concepts exist which may impact the development of a C2 system in a new nuclear state (see Figure 1). These include such considerations as internal, as well as external threats, resource limitations and the issue of secrecy.

It is clear that the regional context will effect a state's C2 structure: close proximity between nuclear armed rivals can exert pressure on the C2 structure to be delegative and maintain an aggressive "use-it-or-lose-it" posture.⁶⁷ Yet internal threats may exist as well. A state may not be volatile in regard to its military forces, as described by Feaver's development of the civil-military paradigm, but by other divisive elements, such as separatist movements, mass protest groups, terrorist organizations or cultural hatreds. Examples might be the Basque Separatists in Spain, the "Greens" environmental movement in Germany, the Irish Republican Army in Britain or the various cultural factions warring against one another in the former Yugoslavia. Any or all of these internal threats could be present inside an emerging nuclear weapons-capable state.

⁶⁵Paul Bracken discusses this concern from the Soviet viewpoint of Pershing missiles stationed in Germany: the Pershings had a four-minute time of flight from Germany to Moscow. See Bracken, 222.

⁶⁶Feaver, 178.

⁶⁷George Perkovich highlights the India-Pakistan circumstance which defies this convention. Perkovich believes that the nuclear rivals on the subcontinent have opted for "non-weaponized deterrence," where nuclear weapons exist in a non-completed, component form. See Perkovich, "A Nuclear Third Way in South Asia," *Foreign Policy*, No. 91, Summer 1993, pp. 85-105.

While Kenneth Waltz believes that nuclear weapons are unsuitable for use in a civil war environment, others disagree.⁶⁸ Regardless of this possibility, in times of massive unrest and widespread civil disobedience, concern for the safety and security of nuclear weapons is at its highest. *It is not impossible to construct the scenario in which minimally-guarded nuclear weapons depots are overwhelmed by mass protesters.*⁶⁹ Three unpleasant possibilities could be envisioned. First, in the chaos, some nuclear warheads are seized by organized crime and spirited away to be held for ransom or sold on the black market to the highest bidder.⁷⁰ Second, during the melee a weapon, lacking safeguards, is accidentally launched or detonated in place. A regional nuclear rival, receiving the nuclear blow, would most likely retaliate in-kind. Or, learning of the detonation through intelligence, the rival may perceive that its opponent had attempted to launch one weapon, which failed, but which indicated that more would be on the way. Thus a hasty nuclear strike would be in order before those weapons arrived. *Such a sequence of events is more plausible during a time of heightened interstate tensions.*⁷¹ A third possibility might be that a nuclear rival would seek to exploit the perceived C2 weakness of its opponent and conduct a pre-emptive strike while the state embroiled in unrest struggled to regain domestic order. Regardless of the scenario, they demonstrate the potentially destabilizing effects that internal crises can have on nuclear C2.

⁶⁸A U.S. government analyst stated that in his view, elements in some new nuclear states would consider using nuclear weapons in a civil war. Interview, 24 May 1994.

⁶⁹A nuclear weapons depot was in fact temporarily overrun by civilians in Baku in 1990.

⁷⁰Seymour Hersh believes this is a distinct possibility within Russia today. See Hersh, "The Wild East," *The Atlantic Monthly*, June 1994, pp. 61-86.

⁷¹Gregory F. Giles puts forth a similar scenario in "Safeguarding the Undeclared Nuclear Arsenals," *Washington Quarterly*, Spring 1993, 183.

Internal threats such as described above could be particularly destabilizing in emerging nuclear weapons states where financial resources are scarce. In such states security budgets may not allow for many elements of C2 considered vital in the West. For instance resources may not be available to develop warhead mechanical safe-arm devices (MSADs), use-control devices such as PALs and ESDs, or to adequately test them. As a result, the safety and security of nuclear weapons would be less certain.⁷² Physical security (fences, armed guards, mechanical locks, etc.) is less expensive. However, budgetary shortfalls might result in the underpayment of troops charged with the physical security of the weapons or warheads. This could adversely effect the morale of these troops to the point of carelessness or worse, vulnerability to bribery.⁷³ Thus, lack of resources for nuclear operations can leave an emerging nuclear state's C2 system vulnerable in the realm of negative control.

Lastly, a new nuclear state's C2 system will be influenced by the overarching decision of that state whether or not to proclaim itself an overt nuclear weapons power or to conduct nuclear operations covertly and join the ranks of "opaque" nuclear states.⁷⁴ Opaque nuclear states must operate under some constraints not felt by the five avowed nuclear states. Nuclear weapons states managing operations covertly are not able to fully develop an integrated early warning and intelligence system such as those enjoyed by the Big Five. Construction of major radar facilities and orbiting of reconnaissance satellites could indicate the existence of a nuclear weapons program. If such components were

⁷²Paul Bracken states that during the early years of U.S. nuclear weapon development, reliability was the primary concern, not safety. See Bracken, 186.

⁷³Seymour Hersh cites the example of a 1991 scheme to purchase a tactical nuclear warhead from a Russian Army lieutenant who had charge over a nuclear weapons storage bunker in East Germany. See Hersh, 72.

⁷⁴Conventional wisdom holds that Israel, India, Pakistan and perhaps North Korea comprise this group. South Africa broke ranks in 1992 when it decided to divest itself of its nuclear weapons.

developed under the pretext of supporting conventional military operations, they may not be well integrated into nuclear operations. During a true nuclear crisis, unexpected developments could occur. Scot Sagan claims that "in large and very complex organizations...one should expect that the unexpected will occur, that unimaginable interactions will develop, that accidents will happen."⁷⁵

Along similar lines, opaque nuclear weapons states also are not at liberty to test (detonate, launch delivery vehicles, etc.) their weapons for safety and reliability. Also, they may be constrained from conducting nuclear C2 exercises to teach proper procedures to the personnel operating the forces and to exercise the connectivity of the entire network. With this limitation, it is difficult if not impossible to know where systemic vulnerabilities exist until discovery during a real crisis. Breakdowns in communications or procedures, whether in attempting to authorize a launch or while trying to relax an alert could lead to "deadly" or "impotent" C2 failures.

Pattern of Civil-Military Relations

stable

volatile

Time-Urgency

small arsenal

limited geography

regional rival

Internal Threats

separatist movements

protest groups

terrorist/paramilitary groups

cultural hatreds

⁷⁵Sagan, 3.

Resource Limitations

technical safeguards
military compensation

Need For Secrecy

no doctrine
no testing/exercises
limited EW/Intel

Fig. 1 The Framework For C2 Development

6. Implications For Stability

All of the determinants of the structure of a state's C2 system reviewed above have implications for stability. It is useful therefore to try to pull together some of these implications in a fashion that will be useful to policy makers, both in new nuclear states and the West, when analyzing the current status or projected development of a state's C2 structure. What is lacking in the current literature is an analytical tool that will reveal some, if not all, of the major vulnerabilities of a C2 system and the corresponding implications for stability. Such a tool, perhaps termed a "checklist for stable C2," would be particularly helpful when applied to emerging nuclear weapon states where information is scarce (see Figure 2). The "checklist" will identify major potentialities for C2 vulnerability and related instabilities that can be explored in greater detail when applied to specific case studies.

The "checklist for stable C2" may be divided into two areas of evaluation: hardware and software issues. Hardware means the physical structures of the C2 infrastructure while software equates to more procedural concerns. Hardware issues

include redundant and robust communications;⁷⁶ strategic or tactical early warning and intelligence alerting systems; protected command centers and intelligence dissemination nodes;⁷⁷ sufficient measures against the effects of electro-magnetic pulse (EMP);⁷⁸ technical safeguards on the weapons themselves, protecting against both accidental detonation (safety) as well as unauthorized use (security).⁷⁹

The checklist's software issues might include such concerns as personnel reliability screening and multi-person control.⁸⁰ Additional aspects of procedure would include exercises of the entire C2 system. In this vein, the existence of codified procedures and training regimes would lead to greater operator efficiency and reduce the likelihood of operator error in time of crisis. Lastly, an item that could be considered under either hardware or software headings is that of "learning mechanisms." A learning mechanism might be a government agency (such as the AEC in the U.S.) or a civilian think tank dedicated towards nuclear operations research. These institutions would work together with nuclear drills or exercises to monitor daily nuclear operations to ferret out vulnerabilities and incongruities in the system to streamline the process.

Hardware Concerns

communications: redundant, robust
EW/Intel cueing
C2 node protection

⁷⁶Soviet leadership went to extreme lengths to insure communications with its nuclear forces. Bruce Blair expounds upon this in Blair, pp. 59-115.

⁷⁷For greater detail see Blair, pp. 120-121.

⁷⁸For examples see Bracken, 112.

⁷⁹Using mechanical safe-arm devices (MSADs), permissive actions links (PALs) and environmental sensing devices (ESDs).

⁸⁰Both of these processes are vigorously used in the U.S. armed services.

EMP hardening
weapons safeguards

Software Concerns

personnel reliability screening
multi-person control
codified procedures, training
C2 exercises
"learning mechanisms"

Fig. 2 The Checklist For Stable C2

D: A TYPOLOGY OF NEW NUCLEAR STATES AND C2 SYSTEMS

It is important to understand that not all new nuclear states, or even potential nuclear states, fall into the same proliferation category. Distinctions are significant in that new or emerging nuclear states will face different constraints which will impact the development of their nuclear C2 systems. Understanding a particular state's constraints will cue the C2 analyst to investigate the vulnerabilities to which that group's C2 is prone.

1. A TYPOLOGY OF NEW NUCLEAR STATES

New nuclear states exist or will emerge from one of three categories of countries: poor, wealthy or inheritor. The majority of current and suspected future nuclear weapon states could be generally classified as poor countries. Current opaque proliferators certainly fall into this category: India, Pakistan and North Korea.⁸¹ Conventional wisdom holds that future nuclear weapons capable states will emerge from

⁸¹Israel and South Africa (before it decided to denuclearize) do not readily fit into this paradigm; neither would be considered "poor" states. Nevertheless Israel's economy would contract sharply if U.S. economic aid (approximately 10 billion dollars per annum) was curtailed. Similarly South Africa found the return on its nuclear weapons investment too low to warrant international isolation and economic sanctions.

within this category as well: Iran, Iraq, Libya, Argentina and Brazil.⁸² Other potential candidates to become nuclear weapons capable states may be found in the wealthy category of proliferant states. Germany and Japan are examples. While not considered to be seeking nuclear weapons, arguments have been made by John Mearsheimer, among others, that the controlled nuclearization of major power states in general, and Germany in particular, would lead to greater international stability.⁸³ Both of these states have strong economies, advanced nuclear technology, fissile material and significant external threats. As a result, conventional wisdom has it that these states could develop nuclear weapons in short order if required to do so.

The third category of new nuclear states is that of inheritor. This category is unique in that only Belarus, Kazakhstan and Ukraine have become nuclear weapon states over night. Although Belarus and Kazakhstan have renounced any claim to pursue an independent nuclear capability, their ability to conduct such operations was limited without assistance from Moscow. Ukraine is more interesting as an inheritor state in that it possess arsenals , C2 structures and a trianed staff from the Soviet Union. However it must now revive the former Soviet system with its own resources.

It will assist the C2 analyst in his quest to determine a new nuclear state's C2 system to know first the broad category into which his target country falls. Knowing the general constraints a country faces will enable the analyst to focus his research along these lines in order to produce a more accurate deductive picture of the target country's C2 system.

⁸²Leonard S. Spector, Nuclear Ambitions, (Boulder: Westview Press, 1990), 6.

⁸³Mearsheimer. "Back To The Future," 38 and "The Case For a Ukrainian Nuclear Deterrent," Foreign Affairs, Vol. 72, No. 3, Summer 1993, 51.

a. Poor Nuclear Weapon States

By definition, poor countries are constrained by their relative lack of resources. Using the general framework developed in chapter two, an economically challenged state is likely to create a small arsenal, particularly in the beginning years of its weapons program. As a result, the tendency will be for a delegative C2 structure, with weapons dispersed and/or hidden, and lower-echelon commanders having predelegated weapons release authorization to offset these vulnerabilities. Poor nuclear countries will have less resources to devote to weapons safeguards, nuclear C2 exercises and, possibly, adequate pay to personnel guarding the arsenal. These conditions lead to the conclusion that typically C2 systems in poor nuclear weapons states will be highly delegative, with favorable applications for positive control, but weak in mechanisms to insure negative control. In a crisis, the likely failure mode would be "deadly."

b. Wealthy Nuclear Weapons States

Countries with more resources at their disposal may produce more nuclear weapons and diversify their means of delivery.⁸⁴ These states might feel that they stand to lose more than poorer countries (international prestige, global economic market share, regional influence, etc.) and so may feel compelled to insure their arsenals' safety and security as much, if not more, than their reliability. To this end wealthy nuclear states will devote resources to weapon safeguards, both internal and external to the weapons themselves. While these points are assumptions, the net effect of such an emphasis may lead to a more assertive C2 system.

⁸⁴All of the Big Five nuclear powers have multiple avenues of weapon delivery. V. K. Nair advocates India's procurement of ballistic missile submarines to enhance the credibility of India's nuclear deterrent. Most nuclear weapons and security specialists agree that ballistic missile submarines offer the greatest degree of protection to a state's nuclear arsenal. In this way they also guarantee a higher degree of stability between nuclear rivals since a second strike capability would be secure.

c. Inheritors

This group is thus far limited to Belarus, Kazakhstan and Ukraine. As Belarus and Kazakhstan have never temporized over their intent to denuclearize and sign the nuclear Non-Proliferation Treaty as non-nuclear states, only Ukraine remains for some speculation. In the case of inheritors it is rational to begin a C2 analysis based upon the C2 heritage of that state. With Ukraine for instance, it inherited elements of the Soviet Union's redundant and robust command system. This system was directed from Moscow and, as the next chapter illustrates, was highly centralized. This being the case, Ukraine's C2 structure may be inclined to accentuate negative, assertive control. Thus C2 vulnerabilities are likely to cause it to fail "safely." On the other hand, critical elements of early warning and intelligence from the Soviet C2 system were not passed on to Ukraine. Further, Ukraine's economic constraints may force it to forego weapon safeguards, should it develop indigenous nuclear warheads, or adequate warhead maintenance, as has been the case with the arsenal it inherited from the Soviet Union.⁸⁵

2. A TYPOLOGY OF COMMAND AND CONTROL

There exists very little analysis on the connection between types of C2 and stability levels. In other words, for every amount of investment made into a state's nuclear C2 apparatus, how great is the return in terms of stability? This is a highly relevant issue to leaders of new or potential nuclear weapon states. Investment into C2 can be a very expensive one.⁸⁶ States with scarce resources do not want to place their national treasure into something if the return is marginal, or worse, negative.⁸⁷

⁸⁵See Perlez, A3.

⁸⁶Bruce Blair notes that the U.S. military budget would have been bankrupted had the government invested in C2 as heavily as did the Soviets. See Blair, pp. 120-121.

⁸⁷After tremendous national investment in C2, the U.S. command system is still vulnerable. See Bracken, pp. 212-213.

Equating C2 investment with stability is also of interest to Western policy makers. If it is likely that an incremental improvement in C2 capabilities will result in correspondingly improved regional stability, then it may be in the West's best interest to assist the new nuclear state to reach a higher plane of C2.

To determine how C2 type equates to regional stability, it is fruitful to consider C2 in general as being divided into four groups: centralized, decentralized, simple and complex.

a. Centralized C2

A centralized C2 system values security as its highest goal. As a result, lower-echelon commanders will not be granted wide latitude in decisions regarding the nuclear forces under their charge. Intrusive mechanisms such as authorization codes from state leaders and multiple-man control will be instituted throughout the nuclear weapon command structure.

The principle vulnerability to centralized C2 systems is timeliness. In times of crisis, the systemic intrusive devices may slow the weapon deployment process down to the point where weapons cannot be used before a rival's pre-emptive strike arrives. Thus a centralized system would likely fail "safely."

The relationship between centralized C2 systems and stability is positive however: a failure in the "safe" mode is unlikely to generate a counter nuclear response from a regional rival. In this way tense inter-regional crises are not exacerbated and escalated by a premature deployment of a nuclear weapon. Also, due to the relatively slow nature of response within centralized C2 systems, false alarms can be evaluated as such and the process of raising alert levels can be reversed before a weapon is released. In this way also, the escalation to hostilities is delayed and stability is buoyed.

b. Decentralized C2

In a decentralized C2 system, national command authority has delegated nuclear weapon release authorization down to lower-echelon commanders. This is done to maximize the goal of reliability: should the NCA be destroyed or isolated by a decapitative strike, lower-echelon commanders would have the standing order to release their weapons in retaliation. In a decentralized C2 system few intrusive devices stand between lower-echelon commanders and their ability to deploy a weapon. The heightened likelihood that a second strike would occur bolsters nuclear deterrence: a nuclear rival will think twice before initiating conflict.⁸⁸ In this way stability too is reinforced.

Yet should a systemic C2 vulnerability arise unexpectedly (accidental detonation, loss of communications at a critical moment, etc.) the decentralized C2 is likely to fail "deadly:" lower-echelon commanders might release their weapons under false pretenses. Such a "deadly" failure would most likely trigger a military (probably nuclear) response and events could spiral out of control. Viewed from this perspective, the interests of stability are not well-served by a decentralized C2 system.

c). Simplistic C2

A simplistic C2 system might be described by its lack of technical sophistication. For example the communication linkages between a state's National Command Authority and its nuclear forces may not be redundant or hardened against sabotage or the effects of electro-magnetic pulse. Simple C2 may have limited or no early warning or other forms of intelligence cueing that can provide the NCA with the proper situational awareness required to make informed security decisions. Weapons release authorization procedures might also be unsophisticated: a telephone call from a

⁸⁸Waltz, Spread of Nuclear Weapons, 18.

state leader to a weapons commander, authenticated by pre-arranged code words. Electro-mechanical locks on warheads or delivery vehicles, such as permissive action links (PALs), might not exist.

Simple C2 could also be described procedurally. For example weapon release authority could reside with only a single state leader, such as the president or prime minister.⁸⁹ Nuclear warhead control procedures may not include multiple-man control each time the weapon is handled. Other procedural glitches might unknowingly exist if the system is not exercised on a regular basis to insure connectivity and the proficiency of C2 operators throughout the system. Similarly, institutions dedicated to the evaluation and improvement of nuclear operations may not exist. Such "learning mechanisms" could function as repositories of lessons-learned so that previous C2 mistakes are not repeated. This would help to streamline the entire system.⁹⁰

The unsophisticated nature of a simple C2 system adds to stability in the sense that there are relatively few technical elements that could fail. For instance, "phantom" enemy weapons launches will not be detected on early warning radar displays because such equipment does not exist in a simple C2 system. The lack of nuclear false alarms increases stability: a state's nuclear forces do not rise to a higher level of alert.

On the other hand, the lack of weapons safeguards could leave a nuclear arsenal vulnerable to accidental or inadvertent launch or detonation. Inadequate procedures for handling nuclear weapons, such as the lack of multiple-man control, could lead to handling carelessness and susceptibility to theft. If a simple C2 system does not

⁸⁹Mitchell Reiss related that the South Africans had not devised contingency plans to replace the president in the nuclear chain of command should he become incapacitated; the president alone held the release authority codes. Interview, 20 May 1994.

⁹⁰Bracken describes the creation and function of the U.S. Atomic Energy Commission to perform this task. See Bracken, 180.

possess some type of nuclear operations "learning mechanism," and is not regularly exercised, it is susceptible to repeating former mistakes unwittingly and continuously. The lack of early warning and intelligence can make state leaders feel isolated, in the dark and vulnerable to actions being planned or executed beyond their borders. As a result, they might react by raising military alert levels which could be reciprocated by rivals and an escalation loop begins.

d) Complex C2

The vertical and horizontal integration of intelligence and computers is the hallmark of an advanced C2 system.⁹¹ An advanced system would incorporate early warning radar, overhead satellite sensors and other forms of intelligence to provide near real-time information to state leaders. Communications in such a system would be redundant and robust. The nuclear weapons themselves would be made one-point-safe and have other electronic and electro-mechanical safing and locking devices.⁹² Procedurally, multi-man control would be instituted, the system would be exercised on a regular basis to ensure connectivity, and learning mechanisms would be in place to evaluate the C2 process.

As a result, complex C2 systems would address all of the goals of nuclear operations: reliability, safety and security. Attempts to approach a balance in all three areas enhances stability. The weapons are reliable, so deterrence is bolstered. They are safe, so that warheads will not detonate accidentally or launch inadvertently. This prevents unnecessary or unexpected crises or crisis exacerbation. Finally, the weapons

⁹¹Bracken, 214

⁹²Either on the warhead itself, the delivery vehicle or both. See Stephen E. Miller, "Assistance to Newly Proliferating Nations," in Robert Blackwill and Albert Carnesale, eds., New Nuclear Nations: Consequences For U.S. Policy, (New York: Council on Foreign Relations, 1993), 116.

will be technologically secure from unauthorized use; this will ease state leaders' concerns about negative control.

Complex C2 systems are not immune from de-stabilizing vulnerabilities, however. Due to the tremendous reliance on technology, component failure in computer or intelligence systems could lead to confusion and the raising of alert levels needlessly.⁹³ Additionally, because reaction time is so critical to complex C2 systems, and intelligence and operations are so tightly fused, the entire structure may become like a coiled spring, waiting to be released into action. Therefore a slight incident, detected by the vast intelligence network, could function to knock the system out of its tense equilibrium and propel the system to automatically rise to higher alert levels.⁹⁴ If not addressed, the system, particularly if highly automated, could seek release authority prematurely. Such activities adversely effect stability.

This chapter developed a general framework for analysis that enables a researcher to better determine what form a new nuclear state's C2 system might take. It also developed a tool to estimate the implications on stability that a new nuclear state's C2 system may have. The next chapter will explore three known models of C2: the U.S., Soviet and South Asian. These models will provide a real world context for further discussion of C2 types and what influences their development. These models could further serve to become the basis for deductive and comparative analyses of any new nuclear state's C2 system.

⁹³The movie "War Games" highlighted how a computer malfunction in a U.S. strategic command and control center almost initiated Global Thermonuclear War.

⁹⁴Bracken, 215.

III: C2 MODELS FOR NEW NUCLEAR STATES

A. THE NEED FOR DEDUCTIVE AND COMPARATIVE ANALYSES

Analysis of C2 structures in new or potential nuclear states cannot be accomplished empirically: the information is not available. There are three reasons why this is so. First, a state's nuclear command and control apparatus is a major issue of national security, such it is highly classified.⁹⁵ The open source literature seldom evaluates C2 systems themselves.⁹⁶ The final reason deduction and comparison is required is that for potential nuclear weapons states, the *arsenals* do not yet exist, much less the systems to command and control them. Nevertheless, as proliferation continues, nuclear C2 systems will evolve, whether their implications for stability are considered or not.

Since nuclear C2 operations in new nuclear states are ambiguous, a context is needed in which to frame a discussion of the issue. This may best be done through investigation of the C2 systems about which the most is known. This is helpful not only because it provides a point of departure for discussion, but also because new nuclear states have to start somewhere also. It is logical that these states will review their nuclear predecessors for guidance on C2 development as well.⁹⁷

⁹⁵Peter Feaver claims that information on the U.S. C2 structure of even forty years ago is difficult to obtain, much less about the C2 in new nuclear states. "C2 in Emerging Nuclear Nations," 162.

⁹⁶Bruce Blair claims that "no one in Washington" is actively pursuing the implications of C2 of potential nuclear-armed states. Interview, 24 May 1994.

⁹⁷Feaver believes that an evolutionary progression exists in the development of nuclear C2 for all new nuclear states. He predicts however that new nuclear states can get a "jump" on this development if they are students of the lessons of older nuclear states. Feaver, 173.

The models of nuclear C2 explored in this chapter for deductive analysis are the United States and the Soviet Union. More is known about these states' C2 systems than any other. Further, they provide two very different perspectives on nuclear operations: the U.S. model is delegative, the Soviet assertive. The model used for comparative analysis is that of India and Pakistan. The South Asian model offers an alternative to the traditional C2 methods of the superpowers in that these states have resource constraints more likely to be experienced by new or emerging nuclear states.

B. MODELS FOR COMMAND AND CONTROL

1. The U.S. Nuclear Command System.

More material exists in the open literature concerning the command and control system of the United States than on any other state's C2. As a result, it is quite likely that other potential proliferating states would review the U.S. model for application to its own C2 efforts. By evaluating the U.S. model, a new nuclear state may be able to learn valuable lessons in C2 without conducting the actual trials and errors themselves, particularly if such a state was seeking opaque proliferation. a. Evolution of the U.S. C2 system

Command and control specialist Paul Bracken takes "what may be called a life-cycle approach to the American command system."⁹⁸ He divides U.S. C2 development into four distinguishable phases: birth, developmental, transitional, and mature. In the initial phase of the U.S. C2 program, the novelty, secrecy, and limited numbers of atomic weapons led to tight centralized control. The Atomic Energy Act of 1946 established the Atomic Energy Commission, within which was the Division of Military Application,

⁹⁸Paul Bracken, , 3.

interfacing between the AEC and the military.⁹⁹ During the early years of U.S. nuclear power status, all atomic weapons and sub-components were under AEC civilian control. Only upon executive order of the President would these weapons and components be released to the military for mating with deployment vehicles.¹⁰⁰ The U.S. President thus had direct, almost personal, control of the nuclear arsenal, which, it must be remembered, was still quite small.

The limitations of this arrangement began to emerge as the result of the Czechoslovakian and Berlin Crises in Europe in the late 1940's and the outbreak of the Korean War in 1950. U.S. military elites argued that the rather cumbersome procedure of linkage to the AEC prevented the military from carrying out its "mandated assignments unless it had prompt access to these weapons."¹⁰¹ By 1953 civilian control of nuclear weapons had become superfluous; in 1956 the U.S. stockpile was turned over to the military.¹⁰²

Bracken describes the period of 1955-1960 as a development phase. Due to the rapid advancement of the Soviet nuclear arsenal in terms of number of weapons and delivery vehicles (strategic bomber force and missile technology), the U.S. perceived the need for a plan to cope with a Soviet attack on U.S. strategic forces as well as new mechanisms that would facilitate the deployment of U.S. nuclear forces at a moment's notice. To achieve these goals, three requirements were identified: a much larger nuclear

⁹⁹Ibid, 180.

¹⁰⁰Ibid.

¹⁰¹Ibid. It is worthy to note that the civilian concern with turning over complete atomic systems to the military was primarily concerned with accidental detonation rather than lack of faith in military commanders.

¹⁰²Ibid, 102.

force, an advanced early warning system, and a more streamlined command structure.¹⁰³ These requirements triggered a host of C2 initiatives which have become the basis of the current U.S. system: a massive investment in early warning systems, the vertical and horizontal integration of intelligence into the C2 structure and the safeguarding and replacement of the president in time of crisis. Nevertheless, the C2 structure of this period remained inflexible in that the overall strategy was based on massive attack or retaliation to a detected Soviet strike; in essence an "all or nothing" approach.

To deal with this, U.S. nuclear planners developed the concept of flexible response: the ability to apply nuclear force in limited amounts and to involve the civilian leadership in whatever application of force was to occur.¹⁰⁴ This transition to flexible response, from 1961-1967, Bracken termed transitional. In order to accommodate this policy shift, the command side of the U.S. C2 system had to be sure that the National Command Authority (NCA) would survive a Soviet first strike. Along with this, survivable communications between the NCA and nuclear forces had to be established. In regards to control, U.S. nuclear forces themselves had to be able to withstand a Soviet nuclear strike requiring hardening of missile silos, etc.¹⁰⁵

The major result of these efforts was increased decentralization of command authority over nuclear forces. Essentially, military commanders of nuclear forces were afforded predelegation from the NCA.¹⁰⁶ As a result of this step, these elite military commanders became the triggers which could deploy the U.S. arsenal, while the NCA now functioned as a safety mechanism. As long as the NCA remained intact, the safety

¹⁰³Ibid, 182.

¹⁰⁴Ibid, 189.

¹⁰⁵Ibid.

¹⁰⁶Ibid, 189

would be "on". If the NCA was decapitated by a preemptive strike, the triggers (the military leaders) would be pulled and weapons would theoretically be launched.¹⁰⁷

To complete the life-cycle analogy, Bracken describes 1968 and forward as the time of maturity of the U.S. system. The modern or mature C2 system is characterized by five factors. First, due to the dramatic increase in the total number of Soviet and U.S. nuclear warheads, the command structures of both sides began to represent weak links in the security structures of both states due to the difficulty of managing large arsenals.¹⁰⁸ Thus, it is widely assumed that nuclear contingency plans focus on the destruction of command and control structures, making these structures more vulnerable than ever.

A second factor is the continued vertical integration of warning and intelligence systems with nuclear forces. According to Bracken, "the system that resulted from these changes must surely be the most technologically elaborate organization ever constructed by man."¹⁰⁹ The resultant effect however, was to produce a command and control system that was so tightly coupled and interdependent that "a small stimulus reverberated worldwide."¹¹⁰ Thus complex layers of checks and balances, "fail safe" procedures and human intervention were required to counter the system's tightness.

Third, the complexity of the U.S. C2 structure has increased considerably. According to Bracken,

"Twenty years of integrating a complex warning and intelligence system into...(the US C2 system) has produced...scores of slanted and horizontal

¹⁰⁷Ibid, 196.

¹⁰⁸Ibid, 214.

¹⁰⁹Ibid, 215.

¹¹⁰Ibid, 215.

lines...(which)...interconnect the commands and numbered armies, air forces, and fleets in a way that violates a smooth flow of authority."¹¹¹

In peacetime this complex structure has proved relatively stable and functional. Under extreme crisis conditions, however, the multiple layers of chains of command and early warning and intelligence conduits would be placed under great pressure and the command arrangement might not function as smoothly as designed.

The technical and regulatory changes that have redesigned the common carrier network of telephone communication represents the fourth facet of the mature U.S. C2 system. The national communication system, established in 1963, was predicated upon a common carrier telephone structure. The giant network of the American Telephone and Telegraph Company (AT&T) filled 85 per cent of government communication requirements and 94 percent of its most crucial circuits through leased common carrier lines.¹¹² The North America Air Defense Command (NORAD), the Strategic Air Command (SAC), the Joint Chiefs of Staff (JCS), and presidential alerting systems are dependent upon these lines.¹¹³ Due to advancement in telephone switching technology and economies of scale, "the network is far less distributed and redundant than it was twenty years ago...less than twenty-five critical nodes handle the great bulk of military communications."¹¹⁴ The locations of these nodes are not classified and were thus undoubtedly known and targeted by the forces of the Soviet Union. The divestment of American Telephone & Telegraph (AT&T) in 1982 and the corresponding rise in

¹¹¹Ibid, 215.

¹¹²U.S. Department of Defense, "Analysis of the Effects of AT&T Divestiture Upon National Defense Security and Emergency Preparedness," June 1981, 5, in Bracken, 217.

¹¹³Ibid, 6, in Bracken, 217.

¹¹⁴Bracken, 218.

telecommunication competition has made "long-term network planning for defense a very low priority."¹¹⁵

The final characteristic of the mature U.S. C2 system is the vulnerability of its physical components. As the U.S. system of command and control expanded to keep pace with the Cold War arms race and related requirements, it came to be realized that much of the physical structures of the system (satellites, ground stations, command bunkers, etc.) needed enhanced protection against assault (military strike, sabotage, or effects on electronics by electro-magnetic pulse from nuclear detonation). The economic cost to protect these systems, through redundancy, hardening, etc., is enormous. Beyond that, in all post-WWII command failings, the issue was never defective equipment. "The real problems have been things like crossed lines of authority, confusion, inability of standard operative procedures to solve problems, and an ineffective integration of political and military decision making."¹¹⁶ Bracken attributes this to the common infatuation with the communication engineering aspects of command and control.¹¹⁷

a. Vulnerabilities of the U.S. System

In order to complete the review of the U.S. C2 system, it is necessary to further evaluate other systemic deficiencies. Bruce Blair states that the primary mission of the modern U.S. C2 system in time of crisis was to achieve a high level of damage expectancy: "the ability in the face of any adversity to demolish the full spectrum of targets in the former Soviet Union."¹¹⁸ As a result, targeting became the main engine that drove U.S. C2. Additionally, the emphasis on damage expectancy and targeting lead to

¹¹⁵Ibid, 219.

¹¹⁶Ibid, 220.

¹¹⁷Ibid, 220.

¹¹⁸Blair, 38.

decentralization of nuclear release authority, or predelegation. Blair claims that "little doubt exists that past presidents, beginning with Dwight D. Eisenhower, delegated to key military commanders the authority to carry out nuclear war plans under some circumstances."¹¹⁹ In line with predelegation, civilian leadership permitted devolution of nuclear operations policy to military planners. Such critical issues as target selection, damage requirements, and assignment of weapons to meet such requirements were solely the military's responsibility.¹²⁰ In sum, the extreme emphasis on targeting, combined with a predelegative and decentralized command and control structure created a system that is predisposed to rapidly bringing all nuclear forces to a high state of readiness.¹²¹ The resulting imperative would then be launch on warning. This overall proclivity to rapid generation of forces focused on launch on warning is what Blair believes makes the U.S. C2 system inherently unstable.

b. The characteristics of the U.S. C2 system

From the above review the U.S. C2 system exhibits the following primary characteristics. It is highly decentralized, technologically complex, emphasizes targeting and maintains an aggressive, launch-on-warning posture.

c. Pros, cons and implications for stability

Due to its decentralization of release authorization, launch-on-warning posture and numerous and varied delivery means¹²², the U.S. has a high second-strike capability. This reinforces deterrence which in turn leads to greater stability between the U.S. and any other nuclear rival. While the above factors have allowed the U.S. to attain

¹¹⁹Ibid, 46.

¹²⁰Ibid, 44.

¹²¹Ibid, 53.

¹²²The nuclear triad: land-based bombers and ICBM fields plus ballistic missile submarines.

the C2 goal of reliability of forces, another beneficial aspect of the U.S. system is that it addresses negative control as well. U.S. nuclear warheads are safe from accidental detonation and secure against unauthorized deployment.¹²³ Thus the U.S. system seeks to address all three goals of C2.

As Blair has pointed out, however, the very characteristics which satisfy the goal of reliability also make for a C2 system which may fail "deadly." Blair claims that U.S. pre-delegation bolstered deterrence against premeditated attack. Unfortunately it risked the chance for "military operations to overrun the intentions of the political leadership and cause the unpremeditated use of nuclear weapons."¹²⁴ Such a failure would strike stability a severe blow.

2. The Soviet Model

Information on Soviet command and control has until recently been limited; Bruce Blair has highlighted some of the most interesting aspects in his 1993 work, The Logic of Accidental Nuclear War.¹²⁵ He points out in great detail the numerous safeguards used by the Soviets to achieve the goals of reliability, safety, and security.

a. Centralized C2 mechanisms

Blair divides Soviet C2 safeguards into those at the top of the C2 structure and below. Similar to the U.S. system, two to three authorities are required for authorization to launch nuclear weapons. The Soviets also employed two distinct modes of operation for their C2 system: manual and crisis. In the manual mode, the commanders-in-chief of the strategic forces are included in the authorization process. In

¹²³Release control devices such as PALs and multiple-man control prevent unauthorized use. However, as U.S. nuclear forces shift from peacetime to wartime alert levels, the degree of authority of lower-eschelon commanders increases. For greater detail on this transformation see Blair, 217.

¹²⁴Blair, 217.

¹²⁵Blair, 53.

crisis mode, when a breakdown in communication is feared, the CINCs are bypassed as launch authorization is held solely by top Kremlin leaders.

Underpinning both manual and crisis modes of operation are the distinctly Soviet concepts of permissive and direct commands. Permissive commands would be sent from the heads of state to the General Staff and the CINCs as validation for the CINCs to then issue direct commands to the nuclear weapons crews in the field. The CINCs' direct command was not sufficient alone. The General Staff then also had to forward a direct command to the weapons crews. At this juncture the two direct commands were combined, validated, re-encrypted and retransmitted to the actual launch crews. Finally, like their U.S. counterparts, top Soviet leaders used portable nuclear suitcases or "footballs" which could be used quickly in times of crisis to provide authorization for use of nuclear weapons.

Below the top echelon of Former Soviet leadership, Bruce Blair cites at least six safeguards which were employed to prevent unsanctioned use of the nuclear arsenal.¹²⁶ The first was the use of two separate organizations and chains of command: one managed the nuclear forces from a technical perspective while the other provided military direction to the actual combat units. A second safeguard was the standard procedure of maintaining nuclear weapons separate from their delivery units. Another standard practice was the use of a two-person control mechanism in every aspect of weapons handling. A fourth practice was the use of elaborate feedback loops which enabled subordinate groups to be closely monitored by higher echelons.¹²⁷ The Soviets also used an extensive electronic network which enabled top leadership to disable launch vehicles and to shut out lower-level command posts from the command loop. Finally, the

¹²⁶Ibid, 90.

¹²⁷Ibid, 217.

Soviets made great use of blocking devices which would physically prevent the unsanctioned use of nuclear weapons.¹²⁸ The end result of all of these command and control policies and safeguards was to produce a Soviet C2 structure that was highly centralized.

b. Soviet fear of decapitation

While the Soviets were extremely concerned with negative control of their nuclear arsenal, they also took seriously the threat to C2 decapitation.¹²⁹ As a result, vast sums were expended to create redundancy and robustness within the command system. Examples of Soviet efforts to enhance the reliability of their C2 system are ground-mobile and airborne command centers, deep and hardened bunkers for top state leaders, multiple and EMP-hardened communication lines between C2 centers and the nuclear forces, even rockets that would deploy communications equipment in the midst of a nuclear attack.¹³⁰

c. Characteristics

Emerging information on the Soviet C2 system indicates that it was highly centralized, redundant and robust.

d. Pros, cons and implications for stability

Like the U.S. model, the Soviets maintained a nuclear C2 system that appeared to be highly reliable; chances were slim for a completely successful pre-emptive strike.¹³¹ This served deterrence and stability. Soviet emphasis on centralization also

¹²⁸Similar to U.S. PALs, these code-activated devices were controlled by top Kremlin leaders to prohibit unauthorized use.

¹²⁹Blair, pp. 124-127.

¹³⁰See Blair, 78.

¹³¹U.S. nuclear planners believed the Soviet C2 system to be highly resilient to either pre-emption or decapitation. See Blair, 121.

enhanced stability. While the intrusive devices made reaction slow, and contributed greatly to Soviet fear of decapitation, at least this type of C2 system was likely to fail "safely."

At the present time in Russia, the nuclear inheritor of the Soviet Union, there is much concern over the physical security of the arsenal. One of the main reasons for Soviet centralization of command was a lack of faith in the lower-echelon troops which operated the nuclear warheads. Under a tightly controlled state security system that the Soviets maintained prior to December of 1991, troop loyalty was not a critical factor. Since that time however, internal security has declined with the erosion of the Communist Party and KGB apparatuses. Also, the power of the Russian mafia has increased. Troop loyalty is now a big issue, for some fear that the physical security of Russia's nuclear arsenal is at risk. Unlike the U.S. military, which is a volunteer and highly professional force, the forces of the former Soviet Union were conscripted and for some years have been disgruntled due to acute housing shortages and the decline of the military's prestige. Seymour Hersh believes that some of these troops guarding the Russian nuclear arsenal are vulnerable to bribery.¹³² The possibility of warhead theft does not bode well for stability.

3. The India-Pakistan Model

There are other nuclear states in the world beyond the Big Five. An examination of how some of these states have perceived their C2 as distinct from the typical Western or Soviet models might reveal an alternative approach that new or potential nuclear states may be following.

¹³²See Hersh, 72.

a. Why a South Asia Model?

There are three reasons why the nuclear operations in India and Pakistan are relevant to a discussion of C2 models. First, the South Asian concept of "non-weaponized deterrence" offers a unique and differing C2 approach to the more traditional U.S. and Soviet models. Also, the regional rivalry between Pakistan and India is likely to be similar to that of other new or potential nuclear states. Finally, these states conduct their nuclear operations under the resource constraints likely to be encountered by new and emerging nuclear states.

1) A third alternative

While it seems evident that both India and Pakistan possess the requisite material to construct nuclear weapons, it is unclear whether or not either country has assembled the various components into deployable devices. In fact, George Perkovich believes that the ad-hoc policies of maintaining unassembled nuclear devices in the arsenals of India and Pakistan may be described as "non-weaponized deterrence."¹³³ Despite the absence of complete weapons, India and Pakistan have the capability to assemble and deploy nuclear weapons in short order¹³⁴ By the end of 1991, It was estimated that India possessed enough plutonium for the construction of 50 to 60 weapons.¹³⁵ Pakistan may have enough highly enriched uranium to have produced 6 to 10 weapons.¹³⁶ Pakistan and India also have the means to deploy nuclear weapons. Both countries possess advanced fixed-wing aircraft that may be modified to deliver

¹³³George Perkovich, "A Nuclear Third Way in South Asia," Foreign Policy, No. 91, Summer 1993, 88.

¹³⁴Woolsey testimony

¹³⁵David Albright, Frans Berkhout and Willian Walker, World Inventory of Plutonium and Highly Enriched Uraium, 1992, (New York: Oxford University Press, 1993), pp. 157-162.

¹³⁶Ibid, pp. 162-67.

nuclear free-fall bombs. Additionally, short and medium range ballistic missiles currently exist in each country's military arsenals and both states are seeking more advanced missile technology to improve range and payload capacity.¹³⁷

2) *Situational similarities*

Pakistan, like other new or potential nuclear states, faces a regional rival which possesses a superior military force. Both Pakistan and India have weak economies, and as a result, are seeking defense on the cheap. Pakistan and India face not only external security threats but internal as well. In Pakistan, civil disobedience in the Sindh province has a long history.¹³⁸ The potential for Sindhi secession also exists.¹³⁹ Pakistan has a history of unstable civil-military relations.¹⁴⁰

3) *South Asian command and control*

Similar to other new nuclear states, substantial literature does not exist about the actual C2 structures of Pakistan and India. A fair amount is known about what these countries do not have, at least according to the criticisms of former high-ranking military officers of both states. Two prominent critics of India's nuclear operations are retired generals V. K. Nair and K. Sundarji. In Pakistan, retired general A. Beg is the primary critic. South Asia proliferation specialist Tim McCarthy claims that both Nair and Sundarji are taken quite seriously by other active duty military officers in India.¹⁴¹

¹³⁷Perkovich, 86. Pakistan has the HATF I and II but may have acquired components for China's M-11 medium-range missile. See Ann Devroy and R. Jeffrey Smith, "U.S. Evidence 'Suggests' China Breaks Arms Pact," Washington Post, 18 May 1993. India possesses the short-range Prithvi and is developing the intermediate-range Agni.

¹³⁸Raju G. C. Thomas, South Asian Security in the 1990's, (London: IISS, 1993), 3.

¹³⁹*Ibid.*, 3.

¹⁴⁰See Stephen P. Cohen, The Pakistan Army, (Berkeley, Calif.: University of California Press, 1984), pp. 105-133.

¹⁴¹Conversation with Tim McCarthy, Center For Non-Proliferation Studies, MIIS, 20 February 1994.

As substantiation to that claim, a prominent Indian military journal recently reviewed Sundarji's book, Blind Men of Hindoostan, a novel critical of Indian nuclear operations, and gave it praise for its applicability.¹⁴²

To improve their C2 structures, India and Pakistan need to fill a few gaps in their respective nuclear weapons posture. Both countries lack three generic areas of concern for an enhanced C2 system: doctrine, specific organizations, and command and control systems. The first is a clear, formalized doctrine for the employment of nuclear weapons. Former Chief of the Indian Army, General K. Sundarji, strongly advocates a doctrine of minimum deterrence for India and Pakistan.¹⁴³ In Nuclear India, V. K. Nair, the former Deputy Director of Strategic Planning at Indian Army Headquarters, outlines in some detail the requirements for an Indian nuclear strategic doctrine. Assuming weapons capability, three necessary areas are declaration, deployment, and employment.¹⁴⁴ In relation to declaration, Nair writes, "the element of fear that has to be perceived (nuclear deterrence) must be communicated by deliberate statements that elaborate the capabilities in being. It is absolutely vital to make the official stand of the government credible if the strategy is to work."¹⁴⁵ In Pakistan, General Mirza Aslam Beg echoes Sundarji and Nair; he believes that "it is myth that nuclear secrecy enhances

¹⁴²Review of K. Sundarji's Blind Men of Hindoostan: Indo-Pak Nuclear War, (New Delhi: UBS Publishers, 1993) by Maj. Gen. Rajendra Nath (Retd.), in Defence Today, Vol. 1(1), August 1993, pp. 149-151.

¹⁴³K. Sundarji, "Regional Arms Reduction and Limitation in the Post-Cold War Era: South Asia," Paper Presented at International Conference on Controlling Arms, 7-10 June 1993, Richmond, Virginia, 3.

¹⁴⁴Vijai K. Nair, Nuclear India, (New Delhi: Lancer International, 1992), 82.

¹⁴⁵*Ibid.*, 82.

¹⁴⁵*Ibid.*, 84.

security."¹⁴⁶ Such "opacity," as it is called, may lead to suspicion, fear, and mistrust by each side for the other which could lead to unpredictable behavior with nuclear weapons.¹⁴⁷ In his view, both undeclared nuclear weapons states are exacerbating regional instability by their secrecy.

Besides maintaining an undeclared nuclear weapons status, India and Pakistan lack policies of deployment. According to Nair, the actual stationing of India's nuclear weapons, or at least components, has not been well developed. The core rationale of a developed deployment policy is to "provide credibility to the declaratory policy."¹⁴⁸ In other words, if the weapons are not deployed, and Pakistan understands this, then deterrence is weakened. Lastly, the issue of employment of nuclear weapons needs to be codified. Nair proposes a number of categories of targets for nuclear weapons. They include striking an opponent's war-making potential, manpower resources, industrial infrastructure and economic base, communications facilities and C2 structures.¹⁴⁹ Essentially, India has a limited or non-existent targeting philosophy. This is much different from the U.S. regime in which targeting drives the existing apparatus.

Not only do Pakistan and India lack basic policy doctrines like targeting, deployment and declarative stance, but also organizations and administrative structures to formulate and execute nuclear policy. The first of Nair's imperatives for India's nuclear regime is the "institutionalization of a body of 'specialists' solely committed to this task

¹⁴⁶Mirza Aslam Beg, "Pakistan's Nuclear Programme: A National Security Perspective," Foundation for Research on National Development and Security, no date, 21.

¹⁴⁷Ibid.

¹⁴⁸Nair, 86.

¹⁴⁹Nair discusses this point in depth, pp. 85-86.

(nuclear doctrine formulation) and directly responsible to the cabinet."¹⁵⁰ India and Pakistan also suffer from rather undefined National Command Authorities (NCA). In India, the Prime Minister retains ultimate release authority¹⁵¹ while in Pakistan it would appear to be held by the senior military officer(s) and possibly the President.¹⁵² The NCA's of both countries need to be broadened to include more people in the inner sanctum of the compliance procedure before release authority is granted. For India, Nair further recommends specialized staff support be afforded to the Prime Minister and other NCA elites. Some of the tasks for such staff include: "threat assessment, development of nuclear policy options, collation and synthesis of intelligence, policy for security of nuclear forces, etc."¹⁵³ If India is considered deficient in these areas, Pakistan may be as well.

The final elements that are missing in the nuclear regimes of India and Pakistan are specific structures of a C2 system. Such structures need to be considered in the categories of command on one side and control on the other. Pakistani General Aslam Beg advocates "the setting up of elaborate command, control and communications structures as was done by the US and ex-USSR during the Cold War days."¹⁵⁴ General Sundarji states that for India, areas requiring attention are: "improving C3, the national command post and the alternative national command post; warhead safety and control to prevent accidental, unauthorized or inadvertent use of nuclear weapons."¹⁵⁵ General Nair

¹⁵⁰Ibid, 92.

¹⁵¹Ibid, 119.

¹⁵²Ibid, 119.

¹⁵³Ibid, 119.

¹⁵⁴Beg, 22.

¹⁵⁵Sundarji, 10.

similarly asserts that India's "C3I infrastructure would need substantial improvements with a special effort to make communications redundant and (improve) increments in the electronic early warning components."¹⁵⁶

b. Characteristics

The main characteristic of the South Asian model, as derived from the criticisms of the former generals, is that of technical and procedural simplicity. The description of this condition is the concept of non-weaponized deterrence, where the nuclear weapons remain stored in a disassembled state.

c. Pros, cons and implications for stability

The South Asian model's primary advantage in simplicity is that weapons are not on the launchpad or alert strip waiting to be released at the first sign of tactical warning. As a result, the likelihood that the system will fail "deadly" during periods of reduced tensions is low. This lower level of nuclear preparedness bolsters stability. This could change, however as interstate tensions increase and the two states transition from a peacetime to a wartime footing. As generals Sundarji and Nair have stated, the lack of early warning and intelligence systems and nuclear operations doctrine indicates that state leaders may be operating in the blind while lower-level commanders will conduct operations during crises on an ad hoc basis. Without more codified procedures and C2 exercises, the chances are good that operator error could occur, possibly to the extent of releasing weapons. Thus under stress, the system would be poised to fail "deadly." This of course would adversely effect regional stability. Somewhat differently, these factors could convince one side that the other's C2 is deficient enough to warrant a decapitative or pre-emptive strike. Whether or not such a strike took conventional or nuclear form would matter little: hostilities would have broken out with enhanced

¹⁵⁶Nair, 126.

possibilities for nuclear exchanges. In this way, a state's C2 system could fail "deadly" through the indirect route of inviting a decapitative strike by a rival.

C. CONCLUSION

This chapter's review of the U.S., Soviet and South Asian models for command and control have revealed that each model has differing C2 system characteristics and implications for stability. Figure 3 depicts how the various C2 models fall out characteristically.

<u>Characteristics</u>	<u>U.S.</u>	<u>Soviet</u>	<u>S. Asia</u>
Centralization	High	Low	Med
few release persons	no	yes	yes
ability to release from center	no	yes	no
troop loyalty	yes	no	yes
feedback mechanisms	yes	yes	no
Technical Sophistication	High	High	Low
redundant, robust comms	yes	yes	no
early warning, intelligence systems	yes	yes	no
hardened C2 nodes	yes	yes	no
EMP hardening	yes	yes	no
weapons safeguards	yes	yes	yes
Procedural Complexity	High	High	Low
personnel reliability screening	yes	unk	no
multi-person control	yes	yes	unk
system exercises	yes	yes	no
codified procedures and training	yes	yes	no
"learning mechanisms"	yes	yes	no

Fig. 3 Characteristics of C2

Now that the "framework for C2 development," the "checklist for stable C2" and the three models of C2 styles have been developed, it is time to apply them to a specific new nuclear state about which very little is known, Ukraine.

IV: UKRAINE'S EVOLVING C2 SYSTEM

Having discussed in Chapter II some of the determinants which work to fashion a C2 structure, and having displayed three models of C2 in chapter III, it is now time to evaluate the implications for stability that a new nuclear state's C2 might have. This chapter will evaluate Ukraine's C2 structure. While an examination of Ukraine's C2 vulnerabilities and potential failure modes qualifies as a fruitful exercise in its own right, it is to be remembered that a similar analysis could be done on any new or potential nuclear state: the general framework and "checklist for stable C2" are generally applicable.

This chapter will first explain why Ukraine is a significant case study. It will then describe the Ukrainian C2 structure based on the "framework for C2 development" and other sources of information. Once a general outline is formed, the "checklist for stable C2" will be applied to it and implications for stability explored. Finally, a suggestive strategy to limit C2 vulnerabilities in Ukraine will be proposed.

A. THE SELECTION OF UKRAINE

Ukraine proves to be a fruitful point of departure in the study of the potential effects of C2 systems in new nuclear states on stability for several reasons. Ukraine is unique in that it is one of only four states (Belarus and Kazakhstan and Russia being the other three) to have inherited nuclear arsenals literally overnight.¹⁵⁷ Unlike Belarus and

¹⁵⁷ Major elements of the Soviet 46th Air Army and the 43rd Strategic Rocket forces Army were based in Ukraine as the state claimed its independence from the USSR in August 1991. These forces were believed to have possessed approximately 1768 nuclear warheads for strategic use (cruise missiles on

Kazakhstan, Ukraine toyed with the idea of gaining operation, or launch, control over its inherited arsenal.¹⁵⁸ Although Ukraine has agreed to denuclearize under the terms of the Trilateral Statement of January 14, 1994, its temporary intransigence created an enormous stir within western arms control circles. As a result, Ukraine's capability to command and control its inherited nuclear weapons became a major issue.¹⁵⁹ Interest over implications for C2 stability should be taken seriously. Christoph Bluth makes the point that Russia's nuclear transportation network is capable of removing all of the nuclear warheads from Ukrainian soil by the end of 1994.¹⁶⁰ Why the Ukrainians bargained for a three year time-table under the Trilateral Statement is unclear if viewed separately from its security needs

Considering Ukraine's security challenges vis-a-vis Russia, its flagging economy, further attempts to operationalize some segments of its nuclear inheritance cannot yet be ruled out.¹⁶¹ Ukraine may elect to develop an indigenous nuclear weapons capability

intercontinental bombers and inter-continental ballistic missiles). See John Lepingwell, "Beyond START: Ukrainian-Russian negotiations," RFE-RL Research Report 2, No. 8 (19 Feb 93), 46-58.

¹⁵⁸ See Appendix A for a fuller account of Ukraine's efforts to this end. This argument continues as to whether Ukraine desired operational control in order to use them as a military asset or simply for international attention and prestige. On this issue see Martin J. Dewing, "Ukraine: Nuclear Weapons Capacity Rising," Master's thesis, (Monterey, CA: Naval Postgraduate School), June 1993.

¹⁵⁹ Even so, the issue with proliferation pessimists is not so much with a new nuclear state having a viable C2 system as over concern over the continuance of the NPT regime in general. Lecture by Stephen Miller at Monterey Institute of International Studies, February 1994.

¹⁶⁰ Christoph Bluth (University of Essex) and Anton Surikov and Igor Sutyagin, (Institute for U.S. and Canada, Moscow). Unpublished manuscript, Spring 1994, p. 5.

¹⁶¹ Vladimir Pikaev, a senior fellow at the Institute for World Economy and International Relations in Moscow (a branch of the Russian Academy of Sciences) stated in a personal interview that some former Soviet gravity bombs may not be accounted for and would make good opportunities for exploitation would Ukraine seek an independent nuclear weapons capability in the near-term. Interview at MIIS, 4 May 1994. Similarly, William Potter believes that of four possible tracks that Ukraine could pursue to obtain fissile materials to construct a nuclear weapon, unaccounted gravity bombs is one way. Interview at the Center for Nonproliferation, MIIS, 6 May 1994.

after the stipulations of the Trilateral Statement have been fulfilled. While the point of the chapter is not to demonstrate whether Kiev will pursue such an option or not, it is a relevant issue and deserves consideration.

- Ukraine's Nuclear Future

Despite the ratification of the Trilateral Statement and START I by the Ukrainian Rada, a denuclearized Ukraine is not a foregone conclusion. Even if Ukraine in good faith adheres to the principles of the Trilateral Statement, nuclear warheads will remain on Ukrainian territory and under Ukrainian administrative control until at least 1997. Pursuing a different option, however, Ukraine may conclude that its brief experience with the inherited Soviet nuclear arsenal taught it at least one important lesson: a nuclear weapons-capable state receives a high degree of international attention, particularly from the United States.¹⁶² Ukraine is still confronted by many of the constraints which influenced many Ukrainian officials to consider an independent nuclear capability: a deteriorating economy, ethnic animosities, a decaying military and increased Russian bellicosity. While short and long-term Western financial assistance and security cooperation is desired by Kiev, they do not represent absolute guarantees of continued Ukrainian independence. As a result, the possibility that Ukraine may seek to possess some form of nuclear weapons capability cannot be ruled out. If this turns out to be Kiev's thinking, what form might such capability take? If Ukraine has learned any other lesson from its time as a de-facto nuclear proliferator, it may be that the overt admission of possession of nuclear weapons generates *too* much international attention. Ukraine may have observed that international arms control agencies have a much more

¹⁶²See Martin Dewing, "Ukraine: Independent Nuclear Weapons Capability Rising," Master's Thesis, (Monterey, CA: Naval Postgraduate School), June 1993, pp. 89-96.

difficult time with the "undeclared" nuclear states of the world such as North Korea at the present time. Thus, Ukraine may elect to re-emerge as an "opaque" nuclear proliferator.

- Status of Ukrainian nuclear technology and industrial infrastructure.

In order to determine whether Ukraine might opt for nuclear opacity, it is first required to explore what Ukraine can do in the realm of nuclear weapons production.

Ukraine currently has only two sources of weapon-usable fissionable material: in the warheads of its inherited nuclear arsenal and in its civilian nuclear power plants: Chernobyl, Zaporozhia, and Khmel'nitski.¹⁶³ Uranium is indigenous to Ukraine; with approximately 350,000 tons of uranium, Ukraine's deposit is the fifth largest in the world.¹⁶⁴ Ukraine does not, however, have a uranium reprocessing facility to develop highly enriched uranium (HEU). On the other hand, plutonium is a by-product of the fission process within nuclear power plants. Thus while it would take time, enough plutonium could be extracted from spent fuel rods to use in atomic devices. Ukraine also has the technical wherewithal to construct a plutonium reprocessing facility to enrich the plutonium to weapons-grade quality.¹⁶⁵ A number of uranium conversion plants exist in Ukraine which produce virtually all other elements required to construct nuclear weapons.¹⁶⁶ One crucial ingredient, tritium, is not available indigenously in Ukraine. Tritium is indigenous to Russia and Kazakhstan, but only Kazakhstan has a tritium processing plant.

¹⁶³William Potter, Nuclear Profiles of the Soviet Successor States, (Monterey, CA: MIIS, 1993), pp. 84-87.

¹⁶⁴Rostislav Khotin, Reuters, 10 April 1992, in Monterey Institute for International Studies Non-Proliferation Review, 93.

¹⁶⁵Dr. Oleg Bukharin, Center For Energy and Environmental Studies, Princeton University; interview 5 May 1994.

¹⁶⁶Potter, Nuclear Profiles, 89.

In the realm of intellectual capacity, some of the most advanced institutions in the Soviet Union for physics, mathematics and nuclear weapons design are located in Ukraine. Some of these include the Khar'kov Scientific Center (Monolit), the Khartron Scientific and Production Association and the ICBM production plant in Dnipropetrovsk, where SS-24's were produced.¹⁶⁷ Many Ukrainian scientists were integral in the design and construction of some of the Soviet Union's most advanced nuclear weapons, delivery vehicles, and guidance systems.

When taken in sum, it is clear that Ukraine possess most, if not all, components and materials to construct nuclear weapons. Many of the Soviet Union's pre-eminent nuclear scientists also reside in Ukraine. This evidence indicates that Ukraine has the potential to develop an indigenous nuclear weapons capability in the near term. Whether or not Kiev will exercise the political will to construct nuclear weapons is another matter.

Ukraine is also faced with internal and external threats to its security and thus threats to Kiev's ability to command and control its nuclear forces. Since claiming sovereignty in 1991, there has been continued debate on the disposition of the some 13 million ethnic Russian living in Ukraine. There has been discussion on dividing Ukraine in half, roughly along lines of the Dnieper River. Fears of a Crimean secession abound.¹⁶⁸ Externally Ukraine faces a seemingly more adventurist Russia, where figures such as Vladimir Zhirinovsky call for Russian intervention to protect Russian nationals in the near abroad.¹⁶⁹

¹⁶⁷Ibid, 84.

¹⁶⁸Steven Erlanger, "Ukraine Chief Accuses Yeltsin," New York Times, 25 May 94, A7.

¹⁶⁹Celestine Bohlen, "Zhirinovsky Cult Grows: All Power to the Leader," New York Times, 5 April 1994, A1.

A final reason that Ukraine makes a good case study of C2 as it relates to stability is that Ukraine struggles with civil-military relations. Christoph Bluth claims that Kiev has only tenuous control over some elements of the Ukrainian military.¹⁷⁰

B. UKRAINE'S EVOLVING NUCLEAR C2 STRUCTURE

The case has been made that Ukraine may elect to develop an independent nuclear weapons capability. It has also been pointed out that the moment a state develops a nuclear weapon, it instantaneously has a de facto nuclear C2 system, whether planned for or not. As a result, it is important to international security to attempt to define, to the extent possible, the form that Ukraine's C2 may take. The particular interest in Ukraine's nuclear C2 is its potential to fail and adversely effect regional and international stability.

In order to define and evaluate a C2 system such as Ukraine's (which may not yet exist), it is necessary to use the analytical tools developed in chapter II of this thesis. First, the general "framework for C2 development" will be applied to Ukraine to identify the likely outlines of its C2 system. the determinants affecting a new nuclear state's C2 development have implications for stability; these will be explored using the Ukrainian context. Next, deductive and comparative analysis, based upon the real-world C2 models examined in chapter III, will be applied to Ukraine to further flesh out the outlines of its C2 structure. Finally, the "checklist for stable C2" will be applied to Ukraine to identify inherent vulnerabilities which could directly lead to a C2 failure with significant implications for stability.

¹⁷⁰Christoph Bluth, "Nuclear Weapons in the Former Soviet Union: Safety and Security Aspects, unpublished manuscript, no date, 29. For an in-depth look at the potential for lack of control in the Russian Republic see Seymour M. Hersh. "The Wild East," *Atlantic Monthly*, June 1994, pp. 61-68.

1. Application of the "Framework For C2 Development" to Ukraine

As indicated at the beginning of this chapter, Ukraine is well-suited to develop nuclear weapons should it exercise the political will to do so. As a result, Ukraine makes for a good case study upon which to overlay the "framework for C2 development" to evaluate its usefulness as an analytical tool for defining the obscure C2 systems of new nuclear states.

a. Pattern of Civil-Military Relations

During the time when Ukraine was a part of the Soviet Union, the military forces of the Soviet Union located in Ukraine were subordinate to Moscow, not Kiev. During this period bipolarity was the order of the day so security threats emanated from the West, not the East. As a result, civil-military relations in the Ukrainian SSR were stable.

This has changed dramatically since Ukraine's independence and the collapse of the USSR in 1991. Multipolarity has become a reality in Eastern Europe and Ukraine has had to reconsider its security challenges. Many security analysts, both in Ukraine and the West, have come to view Moscow as the primary external threat to Ukrainian sovereignty.¹⁷¹ Issues of troop loyalty to either Kiev or Moscow have emerged and continue to be contentious.¹⁷² Amidst the military restructuring in Ukraine, para-military units have developed whose loyalty to either capitol may be suspect.¹⁷³ Ukraine's civil-military relations have thus moved from stable to potentially volatile.

¹⁷¹See "Still on the Prowl," The Economist, Vol. 328, No. 7826, 28 August 1993, 11.

¹⁷²Chrystia Freeland, "Ukrainian Calls for Allegiance Oath," Washington Post, 11 April 1993, A24 and "Morozov: Ukraine to Issue Oath for Strategic Forces," FBIS-SOV-93-068, 12 April 1993, 47.

¹⁷³Bluth, "Nuclear Weapons in the Former Soviet Union," 29.

This impacts Ukraine's C2 development in that it would influence Kiev to adopt assertive control over its nuclear weapons. This could result in a "safe" C2 failure.

b. Time-Urgency

Ukraine is geographically positioned next to Russia, its primary rival. Ukraine thus would have little or not warning of a Russian pre-emptive strike upon its nuclear forces. Additionally, Ukraine is likely to have a small nuclear arsenal based upon its resource limitations and the concept of existential deterrence: only a few weapons need exist to deter. While its geographic expanse is not as small as some new nuclear states such as Pakistan's, it is neither as broad as Russia's. As a result of these factors, Kiev would most likely be highly concerned about the survivability of its nuclear arsenal from possible attack. this could lead to Kiev's adoption of a predelegated to decentralized C2 system. The serious implication for stability is that decentralized systems are more prone to failing "deadly."

c. Internal Threats

Ukraine faces three of the sub-categories of internal threats postulated by the framework: separatist movements (Crimea, Russian nationals), protest groups (anti-nuclear advocates), and cultural hatreds (Ukrainians, Russians, Crimean Tatars). These potentially de-stabilizing factors work together to influence the construction of an assertive or centralized C2 system.

d. Resource Limitations

As indicated previously, Ukraine is in dire economic straits at the present time. Should Kiev decide to pursue a nuclear weapons capability, it might be forced to forego several technical safeguards for budgetary reasons. Ukraine's military budget naturally feels the money pinch as well. Ukrainian troops, like their Russian

counterparts, are faced with housing shortages and inadequate financial compensation.¹⁷⁴ The lack of technical safeguards (PALs, 1-point safe mechanisms, etc.) could lead to failures in negative control which could lead to accidental or inadvertent deployment of detonation of nuclear weapons. Inadequacies felt by Ukrainian forces could lead to conditions ripe for bribery, which also adversely effects negative control.

e. Need for Secrecy

Ukraine's experience with its inherited nuclear arsenal has demonstrated that world opinion is against any new nuclear state which publicly claims or advocates weapons capability. Thus it is likely that should Ukraine go nuclear, it would do so as an opaque nuclear weapons state. If so, many of the components normally considered essential to stable nuclear operations, doctrine, testing, exercises, early warning, etc., would be forfeit in the interests of secrecy. As a result, Ukraine's de facto C2 system would leave national leaders in the dark about external threats while lower-echelon commanders would be conducting nuclear operations on an ad-hoc basis. Kiev would have little foundation for confidence in its weapons or its C2 system. This could lead to a "use-it-or-lose-it" posture. Without adequate intelligence such a posture could lead to premature use, with obvious disastrous effects on regional and international stability.

In sum, three of the five determinants within the "framework for C2 development indicate that Ukraine's C2 would be decentralized and likely to fail "deadly." Moreover, the determinants do not carry equal weight. Likely to be the most important to Kiev are time-urgency, resource limitations and the need for secrecy. These happen to be the ones most indicative of a decentralized system with the propensity to fail "deadly."

¹⁷⁴Corruption is also reported to be high within the ranks. See Oleg Stekal, "No Way to Run an Army," The Bulletin of the Atomic Sciences, 34.

2. Deductive and Comparative Analysis

A second step towards defining Ukraine's existing or future C2 system is to acknowledge its Soviet heritage. This heritage has both a hardware and a software aspect. First, as described in Chapter III under the Soviet model, the Soviets had established a massive C2 complex; some of those elements reached into Ukraine to command and control Soviet nuclear forces there. These elements consisted of C2 bunkers, missile silos, weapons depots and the communication linkages between them. These physical structures remain in place.¹⁷⁵ As mentioned previously, important early warning and intelligence cuing elements were not inherited by Ukraine. The software aspect is that the personnel within the C2 chain were trained in the Soviet Union under Soviet philosophies of C2. As a result, these people, from the National Command Authority down to the military personnel actually conducting day to day nuclear operations, are going to conduct such operations the only way they know how: following Soviet patterns. Knowing what we do of the Soviet model, Ukrainian C2 would likely take a centralized shape.

From the perspective of Soviet heritage alone, it seems that Ukrainian C2 would logically tend to function similarly to how Soviet C2 functioned. However, there may exist some parallels to the U.S. C2 system. For instance, during the early "development phase" of U.S. nuclear operations, the president maintained practically direct control over the small U.S. nuclear arsenal. It is very likely that in Ukraine today or in the future, its nuclear force would be quite small, due to resource limitations. To protect its secrecy, a very limited number of personnel would know of its existence. Even fewer would be

¹⁷⁵The strategic weapons of the 43rd SRF are located at Khmel'nitskiy and Pervomysk. The weapons for the strategic bombers are located at two airfields: Uzin and Prilavki. The C2 headquarters is located at Vinnitsya. William H. Kincade, "Nuclear Weapons in Ukraine: Hollow Threat, Wasting Asset," Arms Control Today, July/August 1993, 14.

entrusted with release authorization; most likely only the president, prime minister or defense minister. This arrangement would indicate a high degree of centralization.

The South Asian model provides a couple of clues. Unlike the U.S. and Soviet models, the C2 structures of India and Pakistan do not appear to be reliant upon technological sophistication.¹⁷⁶ This relative simplicity of form suits Ukraine at the present time due to the lack of economic resources able to be dedicated to C2 needs.¹⁷⁷

A second clue, related to sophistication, concerns intelligence collection and processing capabilities. General Nair states that a major hurdle for Indian C2 "lies in the realm of early warning and attack assessment."¹⁷⁸ Essentially, any C2 system is blind if unable to perceive and assess enemy actions. Ukraine's position in this area of C2 is curious. While it inherited some elements of the sophisticated Soviet C2 system (bunkers, storage depots, missile silos, etc.), it did not inherit the corresponding intelligence aspect. Under the Soviet Union, all intelligence, generally controlled by the KGB and the GRU (military intelligence), was directed from the periphery inwards to Moscow.¹⁷⁹ Thus Kiev was not connected to this intelligence network. As a result, Kiev is now faced with initiating an indigenous intelligence network from scratch.¹⁸⁰ This leaves Kiev susceptible to KGB penetration into its nuclear operations. Ukraine would

¹⁷⁶ Sundarji, Nair and Beg refer to the technical inadequacies of their respective countries' C2 systems.

¹⁷⁷ Until recently, Ukraine's monthly inflation rate has averaged 90 percent. During the winter months energy for heating was rationed. Jane Perlez, "Economic Collapse Leaves Ukraine With Little to Trade But its Weapons," New York Times, 14 January 1994, A5.

¹⁷⁸ Nair, 191.

¹⁷⁹ Blair, 67.

¹⁸⁰ One U.S. analyst made the point that Ukraine's nuclear intelligence apparatus is much further behind Pakistan and India's. India and Pakistan have had nuclear operations ongoing for many years, with concern about preventive conventional attacks on their respective nuclear facilities. Interview 24 May 1994.

also be vulnerable to Russian Spetsnaz attack on its C2 structure. In the realms of technical and intelligence simplicity, Ukraine is similar to the South Asia model.

Through the use of deductive and comparative analysis, the probable shape of a Ukrainian C2 system is beginning to emerge. From its Soviet legacy, it would tend to be centralized. Compared to the early U.S. model, Ukraine's C2 would be controlled by a small group within the government and military, and these elites would have direct control over the nuclear forces: again, centralization. Unlike the superpower models, Ukraine is similar to the South Asian C2 model due to lack of complexity, in the areas of both technology and intelligence.

3. Another Perspective

Vladimir Pikaev offers a more specific description of Ukraine's nuclear C2 structure. He states that the nuclear chain of command in Ukraine runs from the president to the defense minister to the "Center of Administrative Control Over Strategic Nuclear Forces," or TsAUSyAS.¹⁸¹ From this command center the line of authority branches off to both of the strategic force organizations in Ukraine, the 46th Air Army and the 43rd Missile Army (see Figure 4). Pikaev concurs with other reports that Ukraine has achieved administrative control over its strategic forces. Pikaev defines administrative control as the ability to exercise negative control over the arsenal: weapons cannot be deployed without Kiev's approval.¹⁸² He further believes that Ukraine has achieved

¹⁸¹Vladimir Pikaev is a senior fellow at the Institute For World Economics and International Relations (part of the Russian Academy of Sciences) in Moscow. He has studied Russian and former Soviet C2 for many years. According to Pikaev, TsAUSyAS is a Russian acronym. Interview, 4 May 1994. See also John Lepingwell, "The Control of Former Soviet Nuclear Weapons: A Chronology," RFE-RL Research Report, 2 No. 8, (19 February 1993), 72.

¹⁸²See also John Lepingwell, "Beyond START: Ukrainian-Russian Negotiations," RFE-RL Research Report, 2, No. 8, (19 February 1993), 55. Also Blair, 87.

partial operational control of the weapons, in that the nuclear warheads are accessible to Ukrainian personnel.¹⁸³

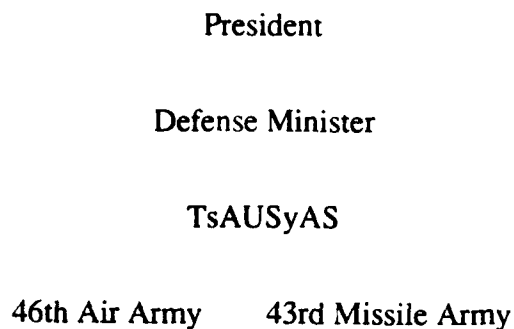


Fig. 4 Possible Ukrainian Nuclear C2

4. Unorthodox Command and Control?

While Pikaev makes a interesting argument, it is not yet clear precisely how far beyond administrative control of its nuclear forces that Ukraine has proceeded. It is generally thought that had Ukraine truly been close to obtaining full operational control of the nuclear forces it inherited, Russia would have raised a tremendous objection or have conducted military operations to have destroyed or confiscated the weapons.¹⁸⁴ As this has not occurred there is much uncertainty about how much control the Ukrainians have over the strategic systems. It is for this reason that it was postulated that Ukraine

¹⁸³Ukrainians could therefore attempt to utilize the warheads on the strategic systems to make gravity bombs deployable on Ukrainian tactical aircraft such as the Su-22 Fencer, which Ukraine possesses. By late 1992 Ukrainian administrative control was thought to have extended to the military personnel responsible for guarding the warheads. See Jeffrey Smith, "Officials See Shift in Ukraine's Nuclear Position," *Washington Post*, 19 December 1992, A10.

¹⁸⁴For a detailed study of Russia's military options in this regard, see James E. Doyle, "Russian Uses Of Force Against Nuclear Weapons in Ukraine: A Scenario-Based Analysis," Contract Paper for Lawrence Livermore National Laboratory, 16 July 1993.

might opt for opaque nuclear weapon status based upon indigenously-produced weapons. The issue becomes this: if Ukraine develops nuclear weapons, will its nuclear C2 system function to make those weapons reliable, safe and secure, thereby promoting regional stability? Or will this system contain inherent vulnerabilities that could emerge unexpectedly to produce a systemic failure leading to escalation into a nuclear exchange? These are the questions that must be asked of C2 systems in all new nuclear states. Ukrainian leaders may be satisfied with the level of C2 they believe their future system will provide. Yet in reality the system may be waiting to fail the moment enough tension is applied. This could transform Kiev's possible confidence in existential deterrence into nuclear holocaust should the C2 system fail deadly. To determine whether or not this is a likelihood, the "checklist for stable C2" needs to be applied to Ukraine.

C. IMPLICATIONS FOR STABILITY

At this point Ukrainian nuclear C2 has been investigated in three ways: through the application of the "framework for C2 development," deductive and comparative analysis to the U.S., Soviet and South Asian models of C2, and by a review of Vladimir Pikaev's description. Each of these analyses reveal implications for stability.

Under the "framework," it appears that Ukraine is more likely to develop a decentralized C2 system which focuses on the goal of force reliability. Evaluated deductively, it would seem that Ukraine would follow its Soviet predecessor and develop a more centralized system with intrusive, assertive control mechanisms in place. Compared to the South Asian model, Ukraine would forgo technical and procedural complexity due to resource limitations and the need for secrecy of its weapons program. Pikaev believes that the system is very centralized but also very unstable.

Taken together, these approaches reveal conflicting signals as to what form Ukraine's nuclear C2 might take. This is not surprising considering the original goals of C2

explored in chapter II of this thesis. The heart of C2 formulation is to achieve an ideal balance between the goals of reliability, safety and security. It is an ideal balance because it can never be totally achieved. As a C2 system seeks to gain more reliability, say through pre-delegation of release authority or dispersal of weapons, safety and security are compromised.

To make more specific predictions about how Ukraine, or any new nuclear state, might fail in its attempt to fashion a balanced C2 system is difficult; empirical data is very scarce. Yet further evaluation is required to try to identify specific vulnerabilities in V2 systems that could trigger significant C2 failures. While such an evaluation will be speculative, it will open up new avenues of additional inquiry that may be pursued to greater degrees as information becomes available. The "checklist for stable C2" as a tool that may be applied to a new nuclear state to open up such an investigation.

D. APPLICATION OF "CHECKLIST FOR STABLE C2" TO UKRAINE

As stated in Chapter II, the "checklist" may be divided into two areas of investigation: hardware and software issues.

1. Hardware Issues.

The first area to be examined is that of communications. Does Ukraine have lines of communications between the National Command Authority and its nuclear forces that are reliable and secure? It has been established that President Kravchuk has achieved at least negative control over the nuclear forces on Ukrainian territory. Thus, some form of communication exists between Kiev and the missile and air fields.¹⁸⁵ What remains unknown is the extent of redundancy and robustness of this system. It is not thought that

¹⁸⁵Blair, p. 88. See also Martin Dewing, 57.

Ukraine has yet deployed any indigenous communications satellites. Instead, Vladimir Pikaev believes that Ukraine is renting satellite time from Russian satellites.¹⁸⁶ If this is so, then Russia controls one aspect of Ukrainian communications and other redundancy efforts, such as fiber-optic cable, are unknown at this time. Even though Ukraine probably has the capability to fashion multiple and secure communication linkages, there is no evidence to support their existence at this time.

The second issue is that of early warning and intelligence alerting systems. Large radar sites similar to U.S. ballistic missile early warning (BMEW's) have not been built and reconnaissance satellites have not been deployed. Like the South Asian model, Ukraine appears to lack sophisticated systems to cue its nuclear forces.

The third hardware issue is whether Ukrainian command centers are sufficiently protected against sabotage and military strike, whether conventional or nuclear. William Kincade postulates that Ukraine could become a viable nuclear power only if it can develop systems "as invulnerable as possible to internal or external interference."¹⁸⁷ Hardened C2 bunkers are technologically within Ukraine's capability but Kincade calls it "economically taxing...for which few resources are available in Ukraine."¹⁸⁸ Kincade's evidence most likely concerns facilities around Kiev because the Soviets in general spared no expense in hardening key C2 nodes. The Command Center in Vinnitsya clearly qualifies as such a node. therefore it may be postulated that key governmental leaders in Kiev lack adequate security but that the military's main nuclear weapons headquarters at Vinnitsya is secure.

¹⁸⁶ Pikaev, interview. 4 Mar 1994.

¹⁸⁷ Kincade, p. 14.

¹⁸⁸ Ibid, p. 14.

Another hardware question is one of adequate protection of electronics against the effects of electro-magnetic pulse (EMP). Paul Bracken states that the U.S. acknowledged the need for EMP hardening only in the mature phase (1968 on) of the evolution of its C2 system.¹⁸⁹ Due to the enormous size of the U.S. nuclear arsenal and attendant C2 system, EMP hardening is very costly. As with the hardening of command and intelligence modes, Ukraine possessed the requisite technology to protect key facilities against harmful EMP effects. Yet the issue in Ukraine is financial, not technological. While the Former Soviet C2 elements in Ukraine are likely to be EMP hardened, any new C2 structures the Ukrainians construct will require hardening. It is doubtful that Ukraine can afford to devote its extremely scarce national resources to EMP protection at this time.¹⁹⁰

A final hardware issue pertains to technical safeguards on the nuclear warheads themselves. The warheads on the inherited ICBM's are believed to have use-control devices installed.¹⁹¹ Whether such safeguards as PALs or ESDs exist on Soviet cruise missiles or gravity bombs is less clear.¹⁹² If Ukraine has, or will, gain the ability to deploy a cruise missile warhead or a gravity bomb, or construct one using indigenous technology, safeguards would have to be installed by the Ukrainians. Such technical expertise also exists in Ukraine. As use-control and warhead safe-arm devices were widely used by the Soviets, it follows from Ukraine's Soviet heritage of central control that they would install these devices on Ukrainian-produced weapons. Once again

¹⁸⁹ Bracken, p. 219.

¹⁹⁰ Ukraine is unable to pay for its basic energy needs at this time. See Jane Perlez, "Economic Collapse Leaves Ukraine Little to Trade but its Weapons," New York Times, 13 January 1994, p. A6.

¹⁹¹ Blair, p. 100.

¹⁹² Ibid, p. 101, 103.

however, Ukraine may believe that this is one more area of nuclear operations that can be (at least temporarily) avoided to cut costs.

2. Software Concerns.

C2 software concerns are essentially issue of procedure. Peter Feaver claims that while hardware measures such as PALs technology are good steps to take to ensure weapon safety and security, they are useless if the authorization codes are "posted prominently on the outside of each weapon."¹⁹³ While this is an extreme and unlikely example, the point is clear. Other procedural vulnerabilities may be equally counter-productive and destabilizing, but much less obvious.

The first item on the procedural side of the "checklist for stable C2" to be applied to Ukraine is personal reliability screening. Under Ukrainian administrative control, nuclear forces would be comprised only of personnel who had sworn allegiance to Ukraine.¹⁹⁴ From Ukraine's perspective, this is a strong step towards troop loyalty to Kiev and not Moscow. Personnel reliability screening, however, is more involved. It includes medical and psychological profiling plus in-depth personal background checks to ensure that individuals who handle and deploy nuclear weapons are free on anything which could adversely effect their abilities to follow orders or function normally around nuclear weapons.¹⁹⁵ While this is standard procedure in the U.S., it is unknown whether this type of screen was conducted in the Soviet Union or to what extent.¹⁹⁶ The lack of a

¹⁹³ Feaver, p. 166.

¹⁹⁴ RFE-RL Research Report I, No. 24 (12 June 1992) : 45.

¹⁹⁵ Examples include checks for susceptibility to mental disorders (depression, paranoia) and financial standing (large personal debts could lead to vulnerability to bribery).

¹⁹⁶ The CIA is concerned that Russia is unable to control scientists leaving the country as no central data system exists on citizens who hold top security clearances to possess state secrets. Jane's Defense Weekly, Vol. 20, No. 20, 13 November 1993. p. 23.

Russian central data system on personnel holding security clearances may be an indication that personnel reliability screening is not conducted systematically either. If this procedural safeguard is lacking in Russia, it is doubtful that it is in place in Ukraine, a state with relatively limited independent experience with nuclear operations.

Another software issue is that of multi-person control. Typically referred to as "two-man control, the procedure's aim is to prevent any one individual solitary access to full control over nuclear weapons. Multi-person control therefore is a procedure that must be instituted at every step of the nuclear weapon process: from manufacture, to shipment, to storage, to use. Multi-person control is central to U.S. And Soviet (now Russian) C2 systems.¹⁹⁷ Vladimir Pikaev is unsure about the extent of use of this procedure in Ukraine.¹⁹⁸ During these unsteady times, Pikaev recommends four-man control.

Conducting nuclear C2 drills and exercises is a different aspect of procedure. Routine exercises of the C2 system work to insure not only that the hardware is operational, hence reliable, but also that those operating it are proficient. Systems and organizations often appear logical in theory or on paper, but it is not until tension is placed on them that weak links or fractures become apparent. Fractures in nuclear C2 structures can seriously erode stability. At the present time, Ukraine is continuing to transfer its nuclear weapons to Russia for dismantlement. It is unlikely that nuclear C2 exercises, however covert, would take place until the transfers are complete.¹⁹⁹

¹⁹⁷ Blair, p. 90.

¹⁹⁸ Interview, 14 May 1994.

¹⁹⁹ During the transfers Russians, and other international observers, are in Ukraine, close to C2 nodes. The Ukrainians would thus be extremely cautious about permitting outsiders to see any aspect of their C2 structure.

Lastly on the "checklist for stable C2" is an item that could fall under the category of either hardware or software: a "learning" mechanism. A learning mechanism is some organization which would monitor nuclear operations, particularly exercises, to watch for weak links or fractures in the system. Ukraine has a state nuclear regulatory agency, the Ukrainian State Committee for Nuclear and Radiation Safety, but it has little authority over civilian nuclear power operations and even less over military operations.²⁰⁰

3. Implications For Stability

This section will recap the item on the "checklist for stable C2" applied to Ukraine as a test case and discuss the implications each item could have on stability.

The first item is that of redundant and robust communications between Ukrainian national command authority and the nuclear forces. While communications exists, it is not redundant or robust. thus, it is vulnerable to strike or sabotage. As pointed out earlier, should communications go out during a time of crisis, a lower-echelon commander might be inclined to "use-or-lose" his weapon. This clearly would lead to retaliation; it has an adverse effect upon stability.

The second item is early warning and intelligence alerting systems. Ukraine seems to lack those systems. As a result, NCA in Kiev is likely to feel very "blind" to events outside of Ukraine and may adopt the aggressive "use-it-or-lose-it" posture. Should tensions rise, Kiev again might want to maintain an aggressive posture. this could lead to a fail "deadly" situation that would drastically effect stability.

The third "checklist" item is command center protection. It appears that the central C2 center at Vinnitsya, as well as nuclear weapons depots and missile silos are

²⁰⁰ Comments by Nicoli Steinberg, Director, Ukrainian State Committee for Nuclear and Radiation Safety, at a seminar, "Nuclear Safety in the CIS: The Regulatory Evolution," in Monterey, California, 12-13 April 1994.

hardened against attack. It is less obvious that C2 centers in Kiev exist or if they do, they are probably not hardened against nuclear blast or sabotage. If this is the case, then should Ukraine suffer either a conventional or nuclear strike by Russia, the civilian leadership would likely be isolated or destroyed, while the military could still possibly deploy weapons. Should Russia even attempt to cut communications from Kiev to Vinnitsya, for instance, this could trigger a deployment of weapons if the military feared decapitation. Such action would be destabilizing.

Similarly, Ukraine has probably not hardened much of its C2 infrastructure in Kiev. While the military command structures might resist the effects of EMP, civilian centers would likely be knocked out. With civilian leadership paralyzed by the effects of EMP, the military once again would have sole authority over the nuclear weapons and may feel inclined to use them.²⁰¹

In the realm of technical safeguards, Ukraine would probably feel inclined to install them on any weapon they would produce indigenously due to their heritage of C2 centralization and due to the large number of ethnic Russians which suffuse Ukrainian society. Ukrainian NCA would not want Russian agents to be able to deploy or detonate a weapon in place as possible rationale for Russian retaliation. Such technical safeguards would have a positive effect on stability.

In terms of procedures, Ukraine does not appear to have a personnel reliability screening program in place. As a result, there is no objective basis for selection of personnel to work within the nuclear C2 system. In this case there exists the possibility that a Ukrainian ultra-nationalist might gain access to the nuclear trigger and seek to pull

²⁰¹This is precisely Pikaev's point. He believes that the Ukrainian Minister of Defense or his subordinate in the Center for Administrative Control of Nuclear Forces has at the present time total control over whatever Ukraine may have in the way of nuclear weapons. No additional authorization (from the Prime Minister, President, etc.) is required to release weapons from the TsAUSyAS.

it in a crisis. This would degrade stability. Similarly, if Ukraine does not utilize the multi-person control procedure, then weapons are vulnerable to theft, improper maintenance or again, potential detonation in place, whether intentionally by saboteurs or accidentally through careless practice. Either way stability would be in jeopardy.

Ukraine may not be ready to conduct nuclear exercises at the present time, due either to concern over secrecy during implementation of the conditions of the Trilateral Statement, or because the nuclear option has not been exercised. If a nuclear system is developed, then exercises would serve to streamline it so that it would be less likely to fail under stress.

"Learning mechanisms" also do not seem to exist in Ukraine. As a result, old lessons would have to be relearned, possibly at great financial or ecological cost. This situation is destabilizing. However, Ukraine, like many new nuclear states, does possess technical research centers and universities. Think tanks from within these institutions could be developed to advise the government and the military on issues of safe and secure nuclear operations. This would serve the interests of stability.

E. CONCLUSION

The "checklist for stable C2" has revealed that there exist numerous vulnerabilities in Ukraine's existing or future nuclear C2 structure. While some may be addressed over time, most are issues which Ukraine seems ill-equipped to rectify in the short-term. As a result, Ukraine's C2 system is likely to fail. It is also most likely to fail "deadly" with dramatic, adverse effects upon regional and international stability.

V: CONCLUSION

Despite the best efforts to thwart nuclear weapons proliferation, new nuclear states are appearing. Some, such as North Korea, are impacting the world community at the present time. Potential nuclear weapons states such as Libya, Iraq and Iran, may emerge later on to threaten the nuclear Non-Proliferation Treaty. Whether one is a proliferation pessimist or a deterrence optimist, it appears that some nuclear proliferation is inevitable. This thesis has attempted to demonstrate that regardless of the merits of the arguments of either pessimists or optimists, a new nuclear state's contribution to regional or international stability rests more upon the nuclear C2 system itself than on the weapons it possesses.

A. C2 IS THE CENTERPIECE FOR STABILITY

Proliferation pessimists contend that irresponsible despots in new nuclear states may gain control over nuclear weapons and use them without regard for the human and environmental consequences. Deterrence optimists counter that the enormous destructive power of nuclear weapons would hold in check even the most aggressive state leader, so long as even a slim chance for nuclear retaliation existed. Pessimists might then say that while state leaders may be conscientious about nuclear use, lower-echelon commanders might not be. They might argue that the more nuclear weapon capable states that exist, the greater the likelihood for a nuclear accident which would yield catastrophic implications for stability. Optimists would rebut this with the argument that any nuclear state would take whatever precautions necessary to insure the safety of such extremely valuable nuclear weapons.

At the heart of this argument is the C2 system. It has three primary functions: to make nuclear weapons reliable, to make them safe and to keep them secure. If these goals could be adequately met, then the vast majority of proliferation pessimists' concerns would be resolved and stable nuclear deterrence would abound. Unfortunately the proper balance between reliability, safety and security is difficult, if not impossible to achieve. This is true of the avowed nuclear weapon states; it is even more profound in new or potential nuclear states. New nuclear states are not likely to have either the resources or the experience to achieve a near balance of these goals. As a result, the nuclear C2 systems will be out of balance and are likely to fail. Systems are likely to fail "safely" or "deadly." This is dependent upon whether the system itself has been developed to emphasize safety and security, or reliability, respectively.

B. ANALYTICAL TOOLS ARE REQUIRED

This thesis has proposed that analytical tools are required to determine the likely C2 structures, vulnerabilities and failure modes of C2 systems in new nuclear states. Since information is generally unattainable to answer these questions directly, a general framework was developed which can predict how a C2 system in a new nuclear state might function. Based on a set of determinants which effect any new nuclear state, the "framework for C2 development" reveals a system's proclivity to be either centralized or de-centralized. Centralized, or assertive C2 systems are more likely to fail "safely" while de-centralized ones are prone to fail "deadly."

While such information is useful to those who are concerned with the attendant effects upon stability that "safe" and "deadly" C2 failures have, what has been lacking in the literature is an analytical device which allows researchers to go beyond general C2 outlines. This thesis has proposed a "checklist for stable C2" which enhances

investigation of specific C2 vulnerabilities which might lead to a system's failure with adverse effects upon regional and international stability.

C. CASE STUDY APPLICATION

To determine how a new nuclear state's C2 system could effect stability, the "framework for C2 development" and the "checklist for stable C2" were applied to Ukraine. Faced with limited economic resources and a powerful regional rival, Ukraine is an ideal candidate to pursue an independent nuclear weapons capability. In this way Ukraine is a good case study. Should Ukraine obtain nuclear weapons, it, like any new nuclear state, would have obtained a de facto C2 system as well, whether any consideration had been given it or not. The "framework" revealed that Ukraine was more likely to have a decentralized C2 system with limited safeguards and procedures. This indicates that should Ukraine's C2 system fail, it is likely to fail "deadly." The "checklist" confirmed this finding by identifying several more specific C2 vulnerabilities that could lead to "deadly" failures.

D. IMPLICATIONS OR U.S. FOREIGN POLICY

This thesis has revealed that the implications of C2 failures for strategic stability is dramatic. It may be difficult to determine which argument has more merit, that of the proliferation pessimist or that of the deterrence optimist. It is not, however, difficult to identify the best interests of the United States: regional and international stability between states. The issue is how to achieve this. The more states around the world that are capable of promoting stability on their own, the better for the U.S. In this way the U.S. is not forced to play the thankless role of global policeman. Instead it can focus its energies and increasingly scarce resources on domestic and economic concerns.

If nuclear non-proliferation efforts are effective at promoting regional and international stability, which is in the best interests of the U.S., then these efforts should

be supported. Yet if non-proliferation efforts are stalled or ineffective, then alternatives should be considered. Although not novel to this thesis, technical and procedural assistance in the area of nuclear operations is such an alternative.

The U.S. should adopt a two-track approach to nuclear non-proliferation. First it should continue efforts to halt the spread of nuclear weapons to potential nuclear states. Second, however, it should identify those new nuclear states which may have C2 systems which have the proclivity to fail "deadly" and degrade stability. Once such states are identified, the U.S. should take bold steps to provide basic technological and procedural safeguards to bolster the safety and security of these states' nuclear weapons. This would decrease the likelihood for a nuclear accident or inadvertent use during the near-term, while longer-term non-proliferation efforts continue. In this way the best interests of all states, both nuclear and otherwise, are served by limiting the likelihood of a nuclear holocaust, accidental or otherwise.

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